### ON THE COVER

EVERY newspaper reader in the nation learned of the Corning Glass Works when it was engaged in the exacting job of turning out the mirror for the Mt. Palomar telescope in California. That was the biggest undertaking in glass in our times and one that had everybody connected with it jittery until the huge piece was safely on its way westward. Even an outsize casting of this type has to be scrutinized for defects that may be too small to escape the unaided eye. Our cover picture shows a Corning technician climbing around the reinforced ribbing of the reflector to check it with an optical instrument.

•

### IN THIS ISSUE

NOT many American cities have hills so high and steep that they interrupt streets. This is true, however, in San Francisco, where the loftiest elevation, Russian Hill, separates the two ends of Broadway. That thoroughfare is now being made continuous by tunneling the hill with twin, 2-lane vehicular bores. Bad ground created unexpected difficulties, but the contractor, Morrison-Knudsen Company, Inc., holed through one tube on January 18 and expects to complete the job next summer. Our leading article gives the details.

•

IT IS hard to keep up with the Corning Glass Works. Periodically we review its activities, but it expands so fast and finds so many new channels to follow that our articles soon grow out of date and incomplete. In this issue we sketch the history of glassmaking and set down some of the recent accomplishments of the glass wizards at Corning. Page 67.

•

ONLY a few years ago a mining company with but one mine usually ceased to exist when it ran out of ore. Nowadays management is more farsighted and seeks to perpetuate the business. When Sherritt-Gordon Mines Ltd. realized more than ten years ago that its base-metal deposit at Sherridon, Manit., was nearing exhaustion it launched a large-scale exploration program and found huge bodies of nickel-copper-cobalt 150 miles to the north. Mining ceased at Sherridon last fall and will be resumed late in 1953 at the new location, Lynn Lake, with pretty much the same equipment and people. By that time the move will have cost $45,000,000 and taken more than eight years. Page 74.

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# Compressed Air Magazine


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VOLUME 57 **March, 1952** NUMBER 3

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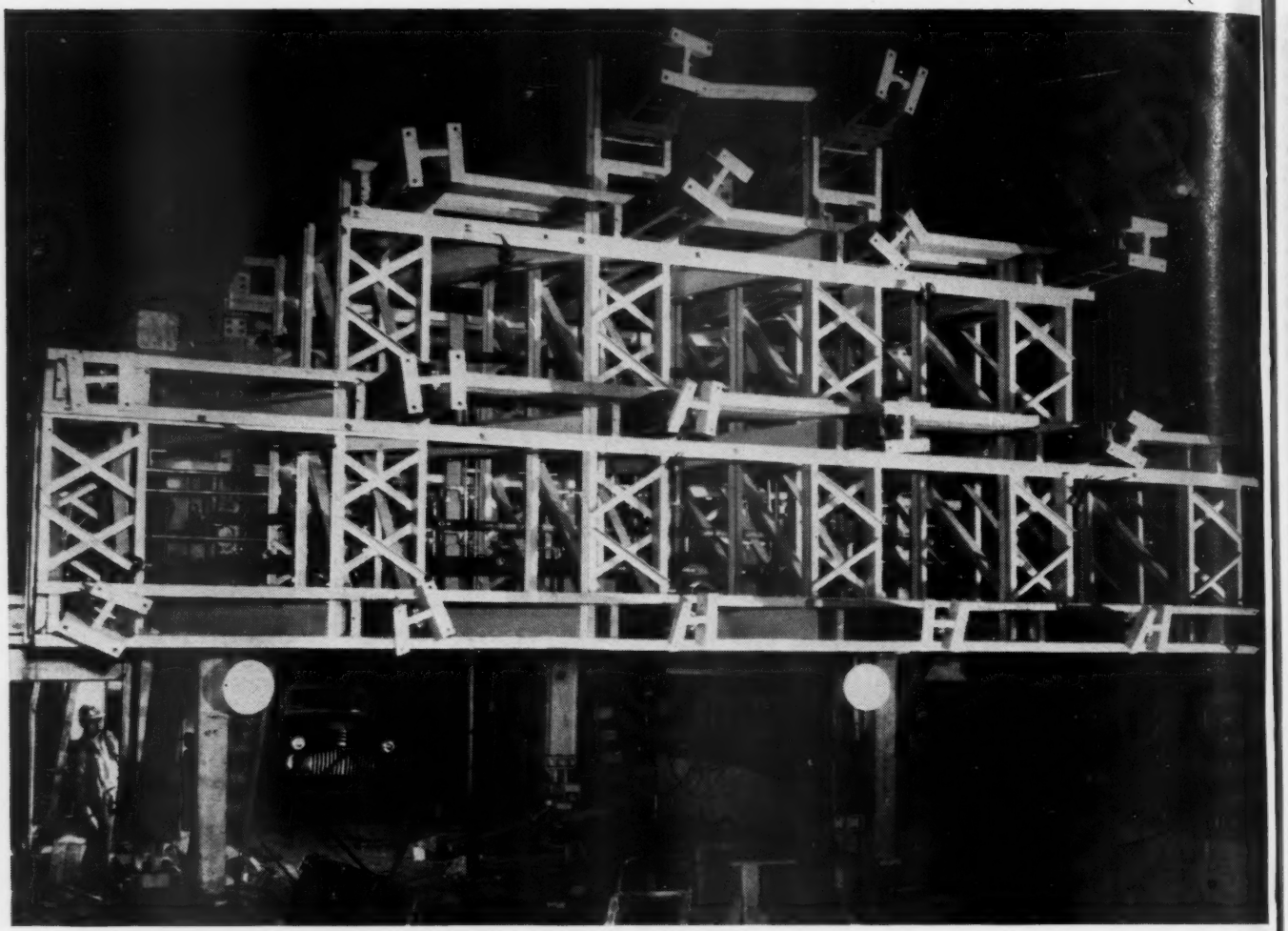
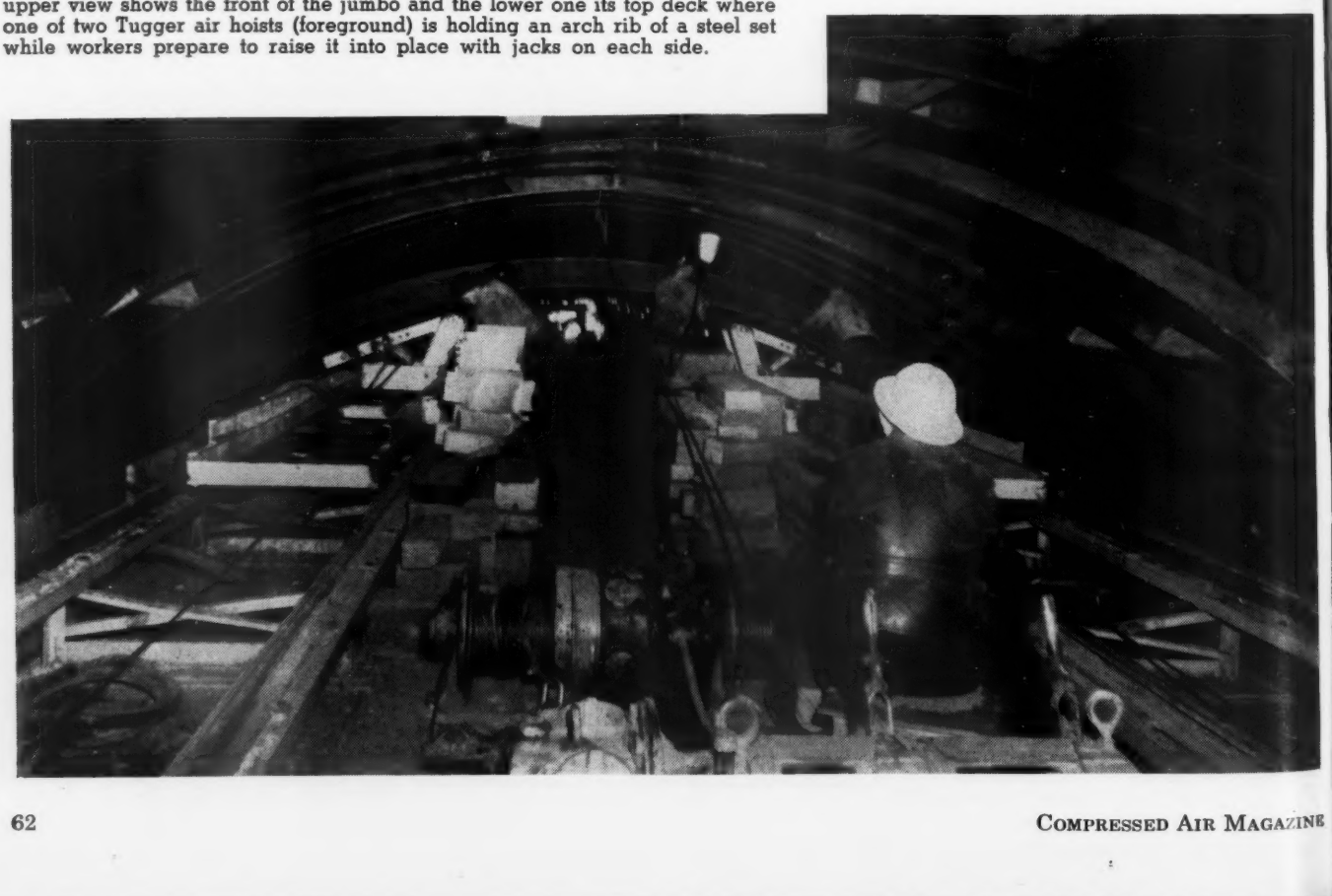
**Published by Compressed Air Magazine Co., G. W. MORRISON, *President;* C. H. VIVIAN, *Vice-President;* J. W. YOUNG, *Secretary-Treasurer.***
**Editorial, advertising, and publication offices, Phillipsburg, N. J.**
**New York City Office, 11 Broadway. L. H. GEYER, *Representative.***
**Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents.**
**COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.**

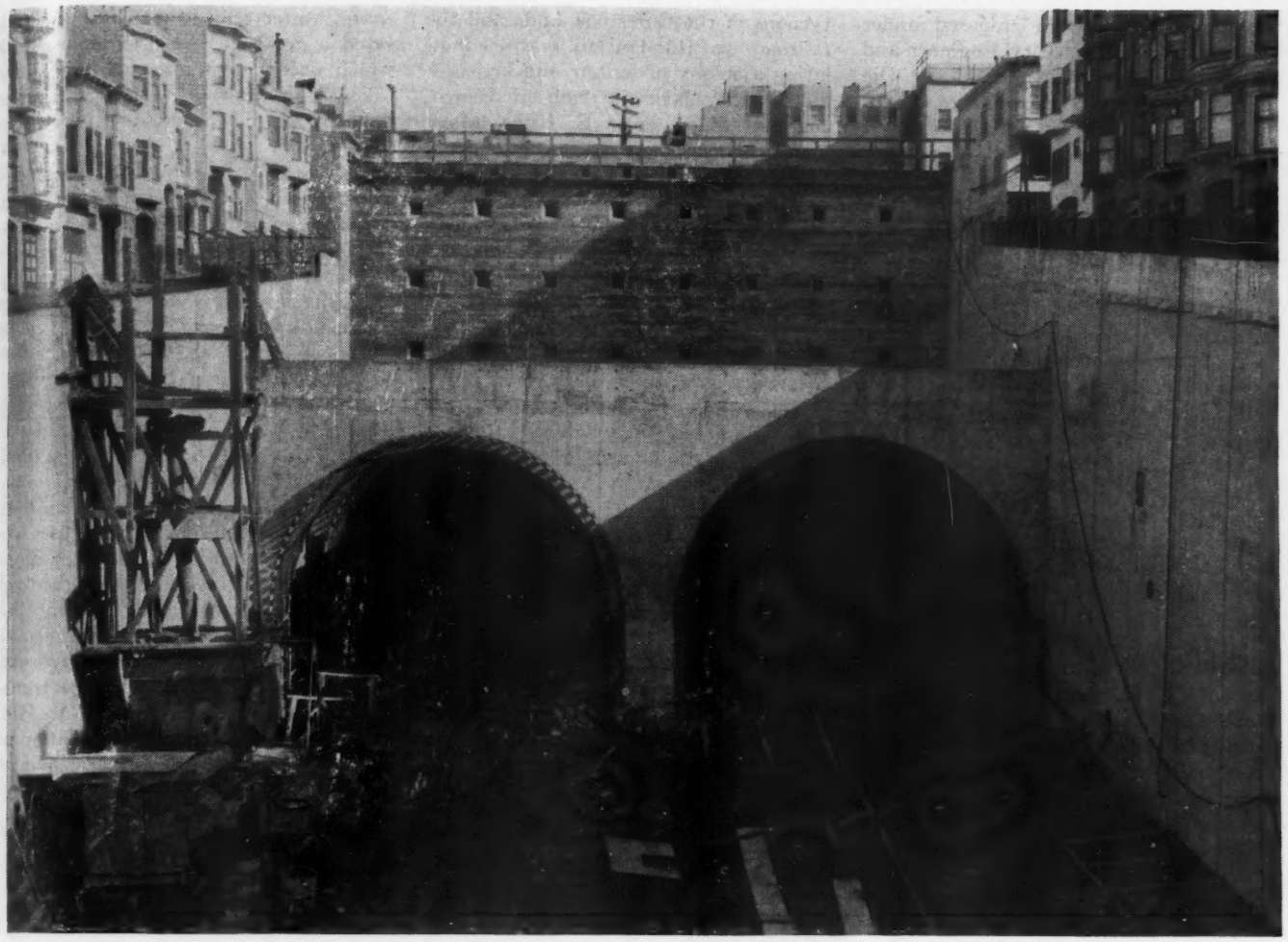


**CONQUERING SOFT GROUND**

Finding it necessary to erect supporting steel immediately after excavating in order to hold up the shifting ground, the contractor devised a breastboard jumbo. Hydraulic jacks in front hold boards against the face to prevent cave-ins and others in rear shove the carriage forward on its wide-gauge rails. The upper view shows the front of the jumbo and the lower one its top deck where one of two Tugger air hoists (foreground) is holding an arch rib of a steel set while workers prepare to raise it into place with jacks on each side.

# San Francisun





**WEST PORTAL**

Steel beams were first driven along the lines of the retaining walls at the sides so the section between them could be excavated and were then encased in concrete. Over the twin bores is the ventilation building with square holes through which fresh air will be drawn in.

# cisunnels Historic Russian Hill

## *Interior of Supposedly Solid Height Proves So Unstable that Special Equipment Is Required*

**L. A. Luther**

WITH the coming of the winter rains a lush growth of grass and weeds literally springs from the cobbles on several streets in San Francisco, Calif. These thoroughfares, with their ancient hand-laid paving, lie at such rakish angles that vehicles, even modern motor cars, run risks when attempting to negotiate the grades. The metropolis still has a considerable mileage of sharply tilted streets ascending its many hills, but the city fathers wisely erected stout barriers at certain points to halt drivers so witless as to attempt to tackle the more dangerous reaches. Even the intrepid cable-car builders of the past century wisely skirted the peaks, leaving their residents to climb stairs or pant up corrugated, non-skid walks.

San Francisco's Broadway extends west from the wide Embarcadero with an apparent intent of living up to its name. It is among the broadest of the city's streets, ascending from the waterfront at an easy grade until it suddenly runs into steep Russian Hill. There, out-of-town visitors may well pause to conjecture whether the boulevard was built especially to carry them to the celebrated fleshpots of Alfred's Restaurant or to the handsome old Nuestra Senora de Guadalupe, the only church in San Francisco in which masses are still said in Spanish.

Since 1856 the citizens have been periodically discussing plans for making Broadway take them somewhere instead of causing them to detour through narrower streets around Russian Hill. Some chose to tunnel the obstruction, others to dig a vast open cut, a task that would have proved difficult judging by subsequent events. San Francisco's Bay and Golden Gate bridges that greatly facilitate travel, and the spiraling population on the Pacific Coast, have increased the need of converting Broadway into a real through way; and with that end in view a bond issue was approved by voters in the 1946 election.

It was decided to tunnel the hill, and the project now underway extends for a total distance of 3300 feet, with a portal to portal length of 1616 feet. It involves driving twin bores, each 28½ feet wide and providing two traffic lanes and a sidewalk. Throughout most of their length, the tubes will be 35 feet apart, with closer spacing at the portals, and the maximum grade will be 3 percent. The tunnels will be lined with light ceramic tile, will be suitably illuminated, and ventilated by blowers in housings at the portals. The plans for

the undertaking were prepared under the direction of the City Engineer and the Director of Public Works, with Ole Singstad, of New York, retained by the municipality to assist with design. A contract was awarded on February 8, 1950, to Morrison-Knudsen Company, Inc., on a bid of $5,253,552, with May 1, 1950, set as the official starting date and April 30, 1952, as the completion date.

It is indicative of the metropolitan character of the location where the work is in progress that the city had to purchase 40 parcels of land in order to secure the essential right-of-way for the approaches and portal structures. Some of the apartment houses and single-unit dwellings were demolished, others were moved back out of the way. It can be appreciated that the city and the contractor faced considerable legal and public-relations problems in carrying out a project of this kind in a thickly populated area.

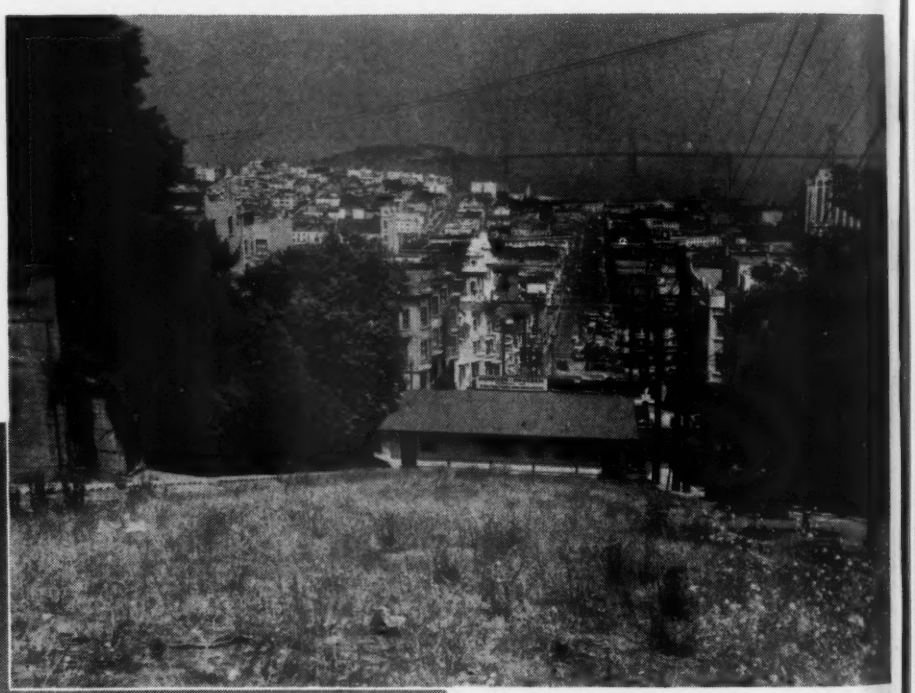
Russian Hill rises to a height of 360 feet, nearly 100 feet higher than Telegraph Hill, the "Loma Alta" of the Spaniards from which a fire signal was flashed to the city on October 29, 1850, to spread the news of California's admission to the Union. Though lower, Telegraph Hill lay a little closer to San Francisco as it was in those days and for that reason was probably chosen to carry the semaphore that relayed signals from the lookout on Point Lobos in the Golden Gate announcing approaching ships.

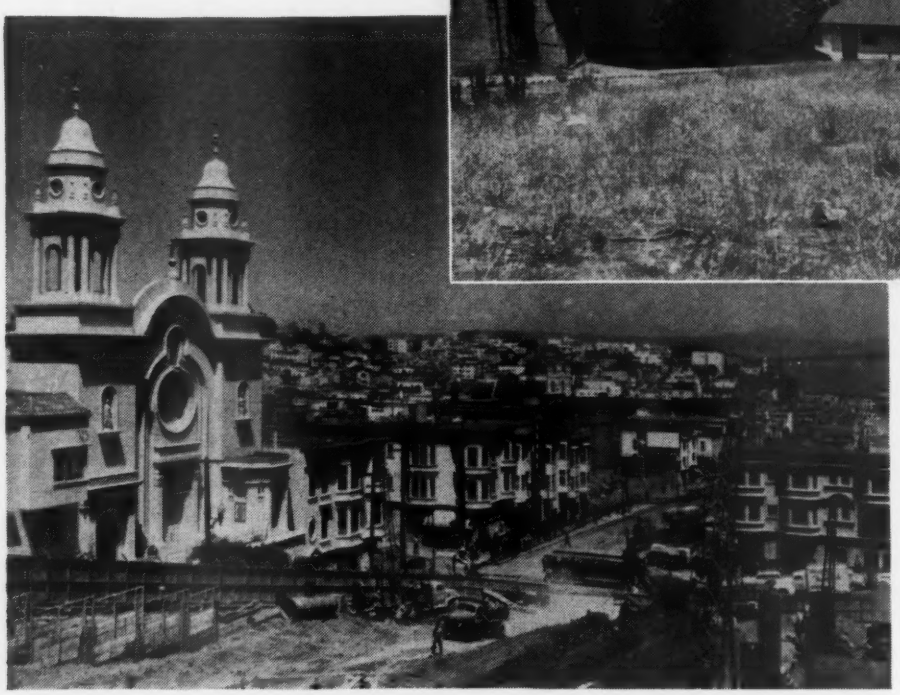
Russian Hill is said to have taken its name from a small Russian graveyard on its summit. It provided a spectacular setting for a gibbet erected there for San Francisco's first public execution. While nearby Nob Hill was attracting tycoons of the Comstock Lode and the railroad era, Russian Hill was accumulating a colony of writers and artists—Helen Hunt Jackson, Ambrose Bierce, Joaquin Miller, Peter B. Kyne, Mary Austin, Kathleen and Charles Norris, among others, who found inspiration in its vistas and sunsets. Commuting up its grades by cable car sparked Gelett Burgess' Ballad of the Hyde Street Grip:

> Rush her on the crossing, catch her on the rise
> Easy round the corners when the dust is in your eyes!

A large percentage of Russian Hill's present population is Chinese, and this presented a language barrier in many instances to the dozen engineers and architects assigned by Morrison-Knudsen, under direction of the project's assistant manager, to examine, photograph, and make notes on every room in adjacent buildings, as well as every foundation and retaining wall. Some engineers having Oriental ancestry were hired for this purpose, and the contractor found property owners, who accompanied parties preparing this documented record or had representatives on hand, both fair and coöperative. Relocating sewer, water and power lines necessitated a great deal of preliminary work which, except for the sewers which were taken care of by the contractor, was done by the city and the utilities concerned.

Cable car versus bus has become a *cause celebre* in San Francisco. Cable-car fans claim that the ancient vehicles, which look a little like Concord coaches on flanged wheels whose drivers manipulate big levers instead of whips, are ornaments and tourist attractions, while the more prosaic champions of the bus condemn them as a time-wasting relic. The two remaining cable lines operated by the city cross Broadway at Hyde and Mason streets, and it was something of a cross for their riders to have the tunnel project interrupt service on both just when the California Street line was tied up with a broken cable and because of an empty purse. Leland Stanford built the latter at great cost for the dual purpose of making San Francisco's other cable lines look shoddy by comparison and to provide sure-fire transport to his home atop steep Nob Hill. But with the contractor's completion of stretches of new track on Mason and





**VIEWS FROM HILL**

Rising 360 feet, Russian Hill is the loftiest of Frisco's noted heights. Near the top, Broadway is so steep that it defies vehicular travel and grass grows among the cobbles, as evidenced by the view above. The building in the center is the Morrison-Knudsen field office. Prominent in the other picture is Nuestra Senora de Guadalupe Church, where masses are still said in Spanish.

**MOVING BREASTBOARDING JUMBO**

After one of the twin bores had been driven from east to west, the huge carriage was taken back by a circuitous route to begin its trip through the other one in the same direction. It is shown being hauled along Bay Street on house-movers' dollies with cables attached to one truck ahead and two behind.

**CHECKING ON SHOCK**

Expecting sound rock and extensive blasting, the contractor hired twelve photographers to record structural conditions of every building in twelve neighboring blocks before beginning the work so that any claims for damage that might be lodged subsequently could be checked. Actually, conditions are such that no heavy blasts are fired, but the intensity of each one is nevertheless closely noted. Here Harry Kirmond, assistant project manager, is all set to take a seismograph reading.

Hyde, and with the city buying a new cable for California Street, the cable-car fans are again riding high.

Data on test borings submitted to the contractor indicated that the formation near the portals was a somewhat shattered Franciscan sandstone, with a hard blue sandstone rated as self-supporting farther in the hill. Unit bids were based on two types of tunnel: an A-section in unstable ground for which a supporting 3-foot-thick concrete lining and a 3½-foot invert were specified, and a B-section with a 2-foot lining without an invert. It was estimated that more than 100 feet at both portals would require the heavier A-type lining.

The contractor had expected to use heavy drifters and to drive the twin bores by the top-heading method, placing wall plates and steel arch ribs first and then removing the central cores with an electric shovel equipped with a shortened boom and dipperstick. But because of the formations encountered he had to change his plans in respect to tunneling, lining and portal structures. As a matter of fact, it has been necessary to secure a time extension on this job, and it has been only through careful engineering and the devising of special equipment that work has been carried out as expeditiously as it has. But before we discuss these phases of the project, let us note the elaborate measures that were taken preparatory to excavating at the east portal to prevent settlement and consequent damage to surrounding structures.

Holes were drilled outside of the excavation lines to a point several feet below final subgrade, some extending to a depth of 65 feet. In them were set "soldier beams"—big I-beams as much as 36 inches in section and weighing 230 pounds per foot. Around them was poured concrete, and all the beams in a row were attached to one another and to those along the opposite edge of the excavation by a rigid assembly of heavy structural steel. The spaces between the beams was filled with wood lagging as earth removal progressed.

This massive grillwork was designed to support a heavier load than permanent walls could carry, and to determine the actual burden imposed on this protective falsework electronic strain gauges were placed on the struts and diagonals. Expansion of the steel on hot days was found to produce extremely heavy strains, and to minimize it the contractor resorted to painting exposed steelwork with aluminum paint, covering some with aluminum foil, and even keeping some surfaces wet.

Nothing in the data supplied by the city indicated that the material between Mason and Taylor streets at the east approach and portal section was not original ground; but when the excavators continued to a depth of as much as 35 feet in rubbish-filled earth, search disclosed a photographic record of an arroyo that had existed at that point and had been used later as a dump. On the basis of this fact, and that the fill carried a great deal of water, the city elected to revise its plans for the retaining walls and ventilating structure.

As the contractor proceeded according to plan and drove top-heading and wall-plate drifts, the entire hill appeared to be settling slowly for a distance of 200 feet. In consequence, it became necessary to pour concrete footings on which to set tunnel ribs constructed of wide-flange 10-inch I-beams. Simultaneously digging in the shattered limestone interspersed with seams of wet clay and placing steel ribs posed a difficult problem, and it was evident from what was experienced in advancing the two 12x12-foot foot-block drifts that the ground was unstable and required continuous support.

At this juncture Lyman Wilbur, chief engineer for M-K, was called into consultation and conceived the idea of using a large breastboard jumbo on a wide-gauge rail mounting. From this structure the heading could be carried forward, and from its upper deck the arch ribs could be hoisted and jacked into position. While the jumbo was being built and set up in the east portal, the foot-block drifts were driven with J-50 Jackhamers on Jackleg mountings, clay diggers and conventional mine cars and muckers while footings for the arch ribs were poured with Pumpcrete equipment.

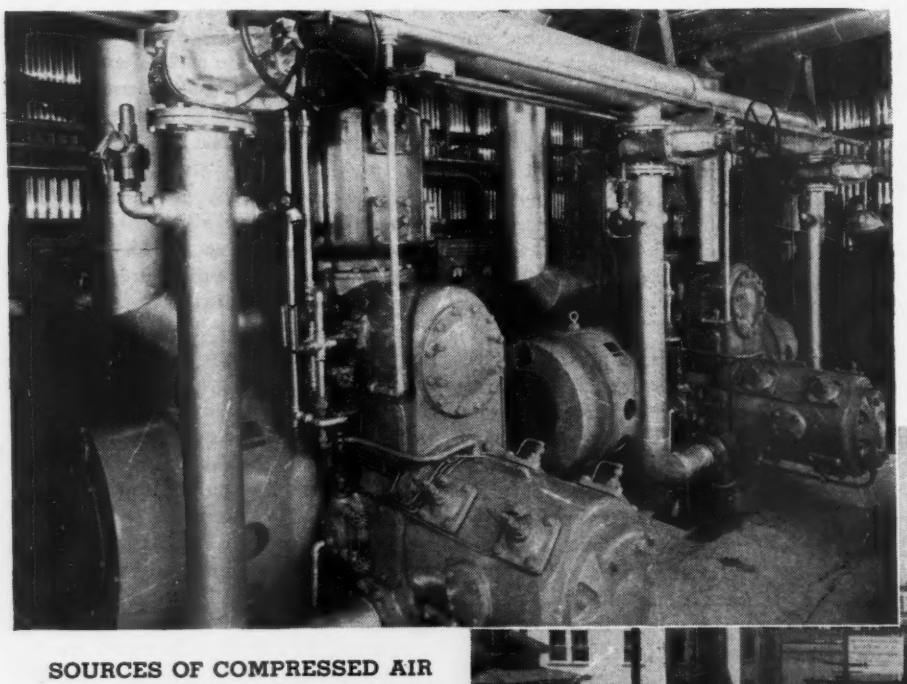
In operating the unique breastboard jumbo, a central plant supplies power to batteries of hydraulic jacks on the front or working end and at the rear. The former apply pressure to as much of the tunnel face as may be desired, while the jacks at the back bear against the arch ribs already in place. By reducing the pressure on the front jacks and increasing the pressure on those at the rear, the jumbo is made to inch forward on its rails. As the arch is excavated, a pair of Tugger hoists lifts rib sections on to the jumbo, where they are bolted together and jacked into position in the arch. Because of the instability of the ground around the east portal, ribs were placed one against the other, the spacing in the finished tube ranging up to 3 feet.

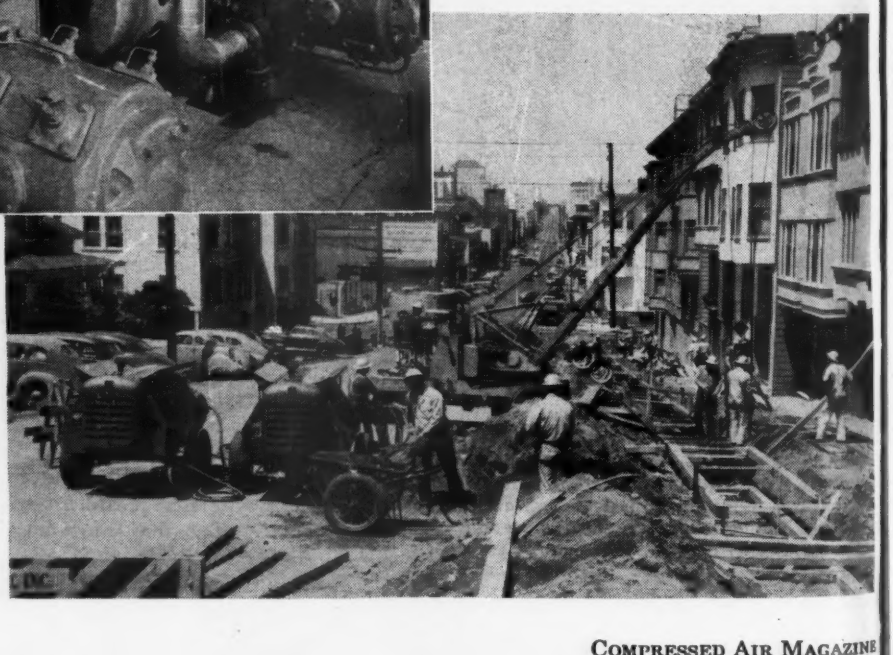
No heavy rock drills have been used up to date, clay diggers and Jackleg-mounted drills being relied upon in excavating from the large jumbo as well as in driving the foot-block drifts. It had been the contractor's intention upon completion of the first bore to take the jumbo apart and truck sections from the west back to the east portal, where they could be reassembled to drive the second and more southerly of the tunnels. But it was figured that considerable time could be saved by transporting the huge assembly intact on house-movers' dollies on the streets skirting the hill. That was accomplished without mishap on January 16 of this year.

The foot-block drifts are ventilated by a 50,000-cfm blower and a 30-inch duct with a Y-fitting from which 18-inch lines carry the air to both of the faces being driven simultaneously. For advancing the main tunnels, this blower is supplemented by two aircraft propellers, each operated by a 75-hp electric motor and exhausting at the east portal. The lining is placed with air-displacement Press Weld equipment, the forms being hydraulically controlled from a special jumbo. Concrete has been used extensively for backfilling because of its stabilizing effect and has been delivered in transit mixers by Pacific Coast Aggregates.

With space at a premium and the air demand fluctuating widely during different phases of the contract, Ingersoll-Rand XLE compressors were chosen as the principal source of air. Three of these compact machines were set up, and their combined output of 2550 cfm is conveyed to all points of the job by a 6-inch line. Two 105-cfm Mobil-Air portables supplied air for the sewer and street work, and double-drum slushers with a rope pull of 2000 pounds at 80 psi were used for a time to move mine cars in drifts. The contractor has provided a handyman service for residents on the hill, thus keeping an eye on settlement cracks, freeing sticking doors when necessary, etc.

Sherman P. Duckel is Director of Public Works for the City of San Francisco, Ralph G. Wadsworth is city engineer, and George Partridge serves on the project as resident engineer. L. L. Wheeler is project manager for Morrison-Knudsen Company, Harry Kirmond is assistant project manager, John Erdle is project engineer, Dan Butler is office manager, Carl Larsen is tunnel superintendent and Jim Miller is master mechanic.





**SOURCES OF COMPRESSED AIR**

Three Ingersoll-Rand Type XLE compressors (above) with a combined output of 2550 cfm supply power for operating rock drills, clay spades, paving breakers, concrete vibrators, hoists and mucking machines, there being more than 100 air-driven units. Each machine is driven by a General Electric 150-hp synchronous motor mounted on the side of the frame so as to reduce the foundation area required. Two I-R portable compressors of 105-cfm capacity are shown at the right. They are being used by the city in relocating a sewer line.

# Glass is Coming of Age

## New Uses Continually Being Found for One of Oldest Materials Made by Man

**J. C. Pierce**

**THE FINISHING TOUCH**

With only a drawing as his guide, a master engraver reproduces an image on a Steuben glass bowl with his whirling copper wheel. Just a few hours before, this thing of beauty was an orange gob of molten glass on the end of a blowpipe in the expert hands of a "servitor" who rolled, blew and coaxed it into an object with some basic shape. Passed on to the "gaffer," master artisan in the shaping of fine glass, it was painstakingly transformed into this creation. Annealing and polishing prepared it for the engraver.

MORE has been done in the past 50 years to increase the usefulness of glass than was accomplished in the preceding 5000. That conclusion was reached after tracing the making of glass back to its roots in ancient Phoenicia and fifth-dynasty Egypt.

The recent spurt of technical achievement in the art is attributable, primarily, to necessity—the need for more special materials with which to bring about new miracles in science and industry. Through this stimulus, and the ingenuity and resourcefulness of the glassmaker, glass has become a highly adaptable tool—an engineering material indispensable to many industries. And those close to glass see in the present high plane of development man's appreciation of its potentialities that will lead it into yet undreamed fields.

Whereas glassmakers in the United States confined themselves in the first 300 years of their activity largely to the production of the general run of articles, they have in the past half century become world leaders in the discovery and manufacture of new products. What they have done and are continuing to do has attracted a great deal of attention and would seem to indicate that glass, long though it has been used, is only now beginning to come of age.

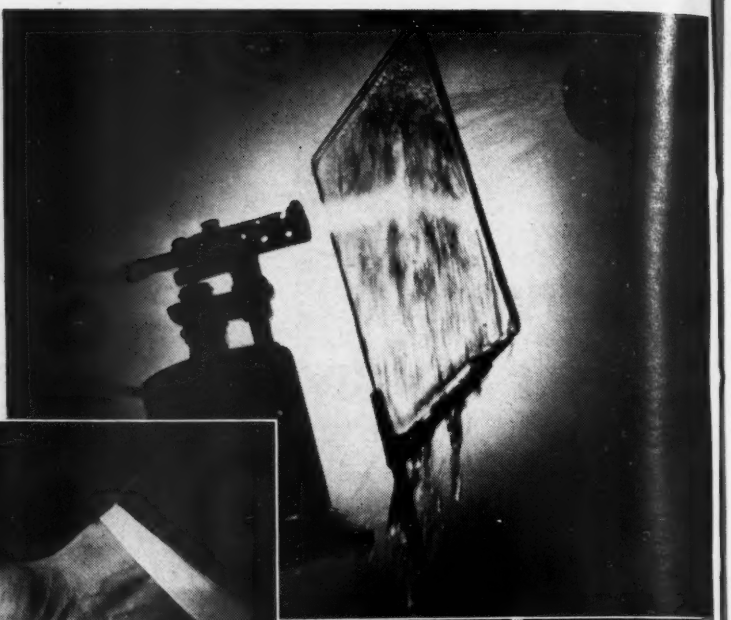
Symbolic of the American glass-making industry is the 100-year-old Corning Glass Works at Corning, N. Y. In celebration of its century of service to the nation, the company opened the Corning Glass Center on May 19, 1951, to commemorate the art of the past but, more especially, to serve as "a solid platform from which to launch an attack into the future." That significant statement was made at the time of the dedication ceremonies by Amory Houghton, Chairman of the Board, namesake

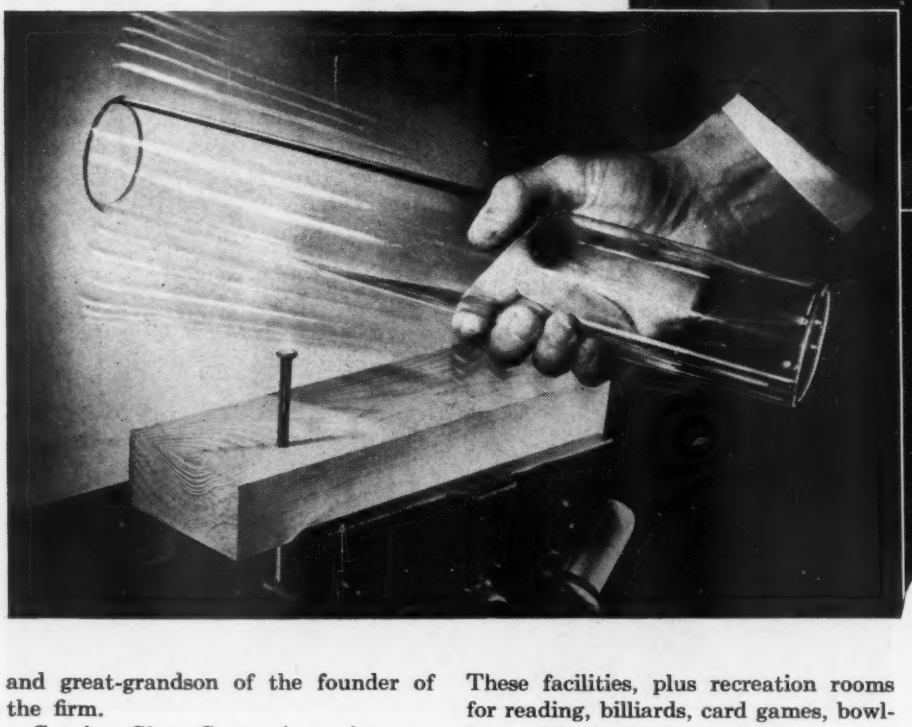
GLASS is a mysterious, fascinating substance. Man has been making, shaping and using it for 5000 years or longer; he has peered into its physical and chemical make-up with the finest of instruments and other technical probes; yet he can't define it in a concise, definite manner.

The scientist will tell you glass is a "super-cooled liquid," or a "liquid whose rigidity is great enough to enable it to be put to certain useful purposes." Although the ingredients of every glass mixture are accurately accounted for, the molecular structure of the resultant products remains a mystery, and we must reluctantly admit that we are not quite sure just what glass is.

**GLASS CAN "TAKE IT"**

Nowadays, glass can be made tough and strong enough to fill numerous structural and industrial applications. In fibrous form, it is the strongest of all materials, pound for pound. Fibers have supported stresses exceeding 1,000,000 psi, but because of surface strains accumulated in normal handling most forms of glass have an ultimate strength of about 10,000 psi. Combined with its electrical insulating property, this makes it extremely useful in electrical equipment, and many miles of fibers from Owens-Corning Fiberglas Corporation have gone into the coil insulation of generators. The man at the lower-right is suspended by a single tape of Fiberglas. So resistant to thermal shock is Vycor brand glass (96 percent silica) that it withstands simultaneous exposure to flame and ice water (right). Below, a piece of borosilicate-glass piping is being used to hammer a spike through an oak board.





and great-grandson of the founder of the firm.

Corning Glass Center is an international exposition of glass—the fulfillment of the company's desire to bring together in one place the historical, scientific, industrial, artistic and sociological aspects of glassmaking to serve as an inspirational force to those that view it. One of the features of the Center is the Museum of Glass, which houses a representative collection of glass from earliest Egyptian days up through the ages to the present. It contains the world's most complete library on the art and history of glass, and in the Hall of Science and Industry are audio-visual means of demonstrating the physical properties of various products and of hand methods of making glass for scientific purposes. Also on display at the Center are today's diversified applications of glass and the basic techniques and formulae ever used in the industry. There, too, it is possible to see how Steuben glass, the finest crystal glass, is formed by hand. All this is provided for the culture, education and enjoyment of the public at large.

For the community of Corning itself, the Center includes a 1000-seat auditorium, a spacious lounge and a snack bar. These facilities, plus recreation rooms for reading, billiards, card games, bowling and basketball, are available to the employees of Corning Glass Works. For them it is a showcase plant where they can see their industry in full review—an enterprise of which they can be proud to be an integral part. For the glass industry it is a monument of achievement; for industry as a whole, a laboratory in human relations.

A walk through the Glass Center is a trip from the beginning of recorded history to the present day. One becomes aware that man has used glass always, although he relied entirely upon Nature's fusions prior to 3000 B. C. Sharp-edged obsidian, that natural glass extruded from volcanoes, gave the Stone Age glass tools, ornaments, weapons and even a medium of monetary exchange. As man progressed, he learned to chip and abrade obsidian into a variety of shapes to serve some of his needs and whims. Then he discovered how glass is formed. According to legend handed down to us in the writings of first-century historian Pliny, Phoenician sailors unwittingly produced glass when they fused sand and soda blocks upon which they heated food on a beach.

Paintings on the walls of Egyptian tombs depict glassmaking as far back as 3000 years before the Christian Era, and about 1200 B. C. the Egyptians developed an open-mold pressing technique. Probably around 100 B. C., at the height of the Roman Empire and long after the ancients learned to make glass and mold it into shape, it was discovered that hollow articles could be formed by blowing air through a crude blowpipe into a molten gob of glass. Although glass is still being blown into shape in that way, most hollow ware is now produced with puffs of air supplied by compressors.

Indeed, it would not be amiss to say

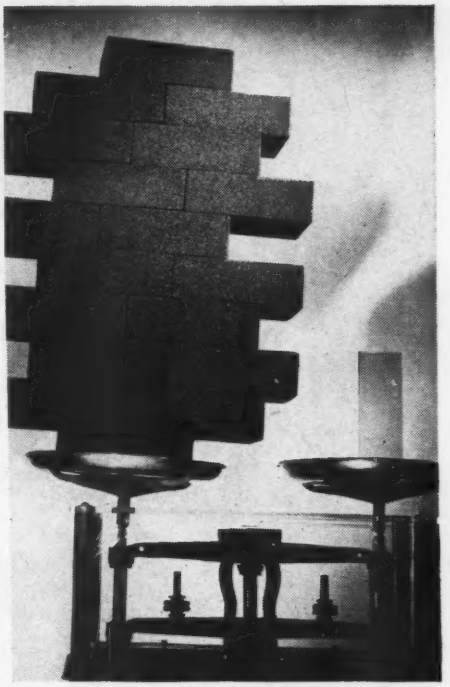
that air is one of the basic raw "materials" of the industry, ranking in importance with the mineral ingredients and the fuel used to melt the mix into a homogeneous mass. In addition to making hollow glassware, compressed air performs other functions in connection with the glass-blowing machines, and it is used extensively at varying pressures to cool men and machines where hot glass mixes are being worked, to open and close molds, to operate glass presses, to convey glass sand, and for numerous other purposes.

The degree of cultural attainment and the relative prosperity of an epoch long gone can often be closely gauged by its remains. Perhaps there is no better indicator of what has gone before, no better tell-tale, than glass relics passed down through the ages. At the museum in the Glass Center there is a magnificent glass display which tells the story of civilization: traces the spread of the art from the Egyptian to the Greek and Roman empires — depicts the Syrian and Venetian eras of intense glass culture — and portrays the Persian, French, German and English glassmaking practices. Clearly evident are the transitions from the ancient and medieval to the modern scientific, industrial and aesthetic aspects of the art.

The beginning of the modern age in glass is generally considered to date variously from the sixteenth or seventeenth century when the material first became a tool of science. Though spectacles, which were introduced in the mid-thirteenth century, are not in that category, they must be recognized as the door opening to scientific glassmaking. Spectacles came into being simultaneously in China and Italy, and optometry was still a young profession with a questionable future when the invention of the printing press (1454-55) brought a surge of business. The flood of new printed matter made people conscious of their eye deficiencies, and customers were not hard to fit. If nearsighted, they got a concave lens; if farsighted, a convex lens. If old, they were given a lens of strong magnification; if young, one of weak magnification. That was all there was to it.

It was the curved lens that brought about the microscope and telescope somewhere between 1590 and 1608, thus raising the status of glass from the bead and tumbler to the optical instrument. The thermometer, camera lens, and reflecting telescope followed in quick succession, and before the end of the seventeenth century Newton had resolved light into its constituent colors, which led to the creation of the spectroscope. These developments opened new vistas in the celestial dominion and the bacteriologist's laboratory.

Coincidentally, a new world was in the making across the Atlantic in America, and the settlers lost little time in building a glassmaking plant—their first authentic industry. It was established in Jamestown, Va., and some of the products from that "glass house" may have been the first made-in-America export items. But that plant, which went into production in 1608, was operated only intermittently by imported Dutch and Polish workers who turned out crude bottles and other articles most needed by the colonists. The enterprise did not flourish and was wiped out in the Indian massacre of 1622. However, the plant was soon replaced by another run by refugee Venetian glassworkers sent over from London specifically to make brightly colored beads with which the British could barter with the Indians for tracts of land.

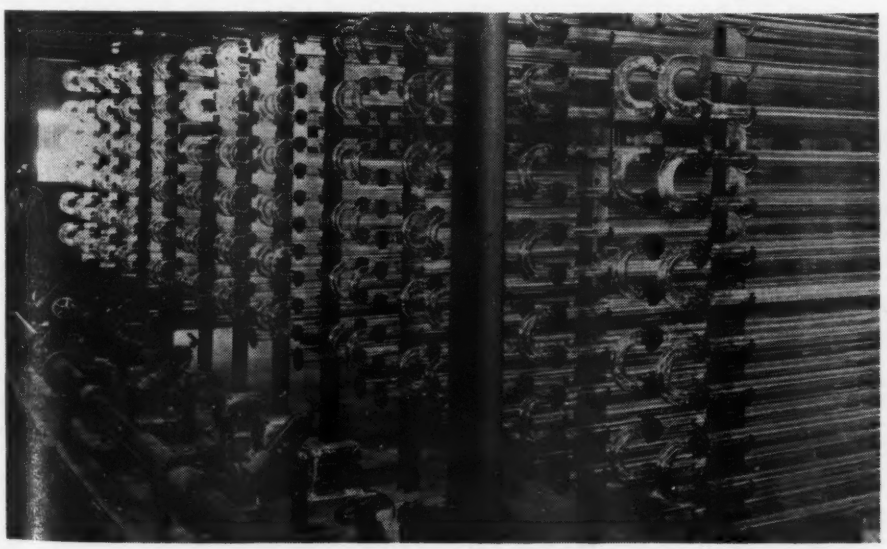


**INSULATOR PAR EXCELLENCE**

Eighteen Foamglas bricks (volume, 864 cubic inches; weight, 4.81 pounds) exactly balance a 24-cubic-inch block of optical glass. Foamglas is produced from powdered glass and finely divided carbon and is characterized by myriads of tiny gas-filled cells. In bulk, or made into bricks and blocks by use of a binder it is an excellent heat insulator. Among its advantages is its workability —it can be easily sawed.

History does not give enough credit to glass for being a factor in winning the eastern strip of America from the aborigines. Many a scalp was spared by the gift of a few shiny beads and the promise of more. Land valued today in the millions of dollars was granted to the colonists in exchange for small packets of glass objects. In 1641 a plant in Salem, Mass., started a more diversified line with the production of window panes, bowls, bottles, pitchers and lamps, again only what was in greatest demand. Four years later, with two furnaces being fired in its vicinity, New Amsterdam on Manhattan Island became the glass center of America.

Since nearly all the proprietors and workers were foreign born—English, Dutch, German, Bohemian, Polish, Venetian—American glassware of the seventeenth and eighteenth centuries plainly reflected the European influence in both design and method of manufacture. Noteworthy among those early glassmakers was German-born Caspar Wistar who, in 1739, imported some Belgians for his Salem County, New Jersey, establishment which thrived for the next 42 years. Any story of glassmaking in this country must include mention of artist-industrialist Henry

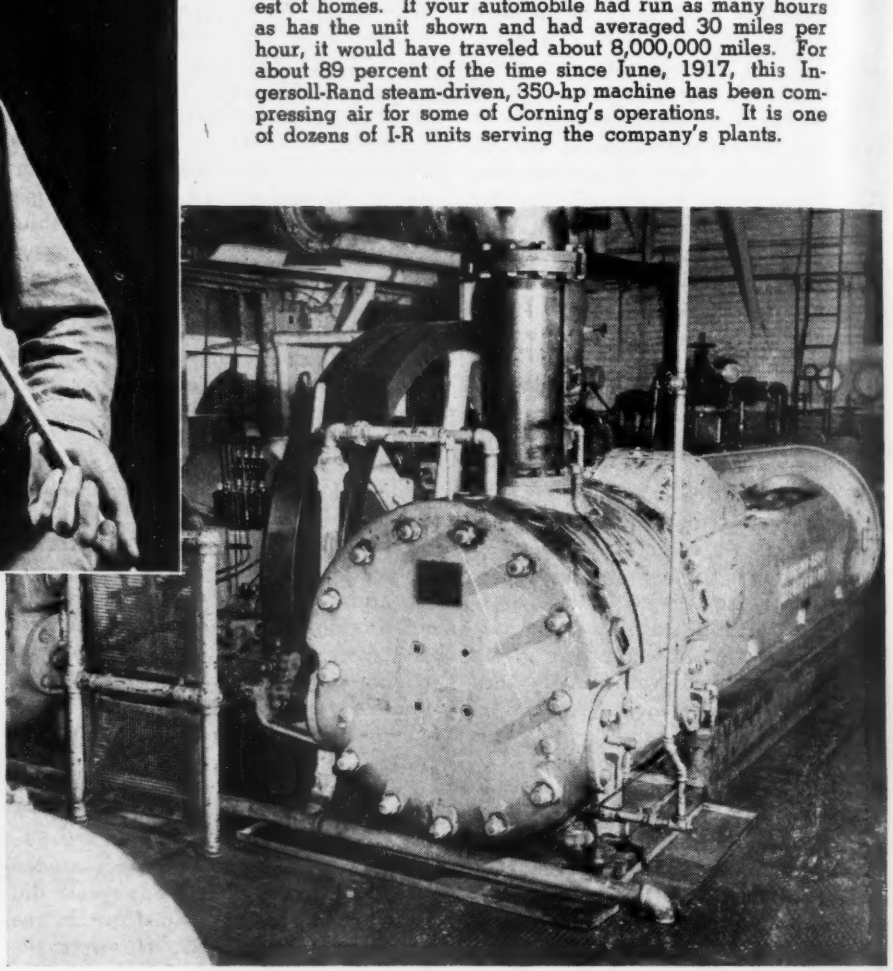


**NOTHING HIDDEN**

The use of industrial piping that "can't keep a secret", is growing fast. Improvement in chemical stability, choice of fittings, joining assemblies and field welding apparatus have increased its applicability. It comes in sizes up to 6 inches inside diameter. Glass pumps also are available.

**GLASS AND AIR**

**There is hardly an operation in a glassmaking plant that does not use air compressed by lung or machine. The freehand glass blower still plays an important role in the art, although the mechanical compressor is responsible for placing hundreds of useful glass articles in the poorest of homes. If your automobile had run as many hours as has the unit shown and had averaged 30 miles per hour, it would have traveled about 8,000,000 miles. For about 89 percent of the time since June, 1917, this Ingersoll-Rand steam-driven, 350-hp machine has been compressing air for some of Corning's operations. It is one of dozens of I-R units serving the company's plants.**



William Stiegel who migrated from Germany in 1750 and gave America its first fine lead-flint glassware. The products of his furnaces are collector's items today.

The decline of the Renaissance towards the close of the eighteenth century (the era in which creative art in almost every phase reached a pinnacle) and the beginning of the industrial revolution caught the glassmaking industry in its sweep. Although automatic machines for shaping glass did not appear until 1899, when Michael J. Owens invented a bottle blower which led to production-line methods, machines accessory to time-honored glass-blowing equipment made their debut in the early 1800's.

Into this picture stepped Deming Jarves and his New England Glass Company established in Cambridge, Mass., in 1815. Jarves improved upon a crude pressing machine invented by Enoch Robinson, a worker in his factory, with the result that pressed ware became available to a large and growing public. That concern, and the 1825 Boston & Sandwich Company of which Jarves became part owner, were America's first large-volume producers and flourished for more than 50 years. Subsequently, when the artisans in the glassmaking field turned to stone and paint, there was a lag in creative artwork, which has been revived in the past five decades through the efforts of such well-known American firms as Libbey, Fostoria, Viking, Cambridge, Imperial, Heisey, Duncan & Miller, Tiffany and Steuben.

Amory Houghton, Sr., conducted a successful wharf business in East Cambridge, Mass. A man of vision, he sold out and started the Union Glass Company in 1851 at Somerville, Mass. There he produced fine cut glass for thirteen years. In 1864 he disposed of that plant and used the proceeds to purchase the Brooklyn Flint Glass Company. Then, in 1868, he chose Corning, N. Y., as the site for what was to become the Corning Glass Works. From that modest beginning has grown a network of fourteen factories in six states and Canada employing directly some 13,000 persons. To manufacture and distribute products not in the regular Corning line, the company has established affiliate organizations such as the Pittsburgh Corning Corporation which makes building blocks and Foamglas, the Owens-Corning Fiberglas Corporation which turns out insulating material and the Dow Corning Corporation which supplies many silicone products.

"Corning Means Research in Glass." That was the slogan the organization adopted early in its history, and that has been its guide through the years. From cut and blown tableware, lantern globes, lenses, thermometer tubing and cane (slender cylindrical rods) made in its first small plant has grown a list of items numbering more than 37,000. There was a period when the manufacture of tableware was dropped in order to add to the facilities for making more practical commercial articles, and at that time the production of scientific glassware became an important part of the company's activities. Perhaps its first outstanding accomplishment in this department was the blowing of bulb blanks for Thomas Edison's incandescent lamp in 1879.

Early in its history, the Corning Glass Works recognized the importance of improving and standardizing railroad signal glass and has specialized in this field. Heat-resistant glass, hollow glass building blocks, Foamglas, fiber-glass products, the 200-inch Mt. Palomar reflector disk, photosensitive glass and television tubes also are among Corning's triumphs. And research under a staff of some 250 experts is continually adding new formulae to the more than 50,000 already on file at Corning. Of Nature's 98 known elements 84 are used in its glass mixes to meet the manifold requirements.

Contrary to what might have been expected, the coming of mass-produc-

tion through the advent of automatic glassmaking machines increased employment in the factories. The resultant reduction in operating costs meant lower prices to customers, and the public responded. More workers were needed in all departments to turn out the greatly expanded volume of goods. And, unique among industries, the machine did not entirely replace arduous hand methods, for a large section of one plant at Corning is still given over to free-hand blowing and open-mold hand pressing of industrial ware. In the Glass Center one is able to see Steuben craftsmen creating by hand forms that machines cannot fashion. Perhaps it is this fact that is partly responsible for the great attention Corning pays to human relations—for its recognition that the people it employs are its most important resource and that machines are made to serve not replace man.

The glassmaker who shapes articles of usefulness and beauty from drab sand, lime and soda ash has always been regarded with respect and often with awe. The Venetian republic of the sixteenth century grew in wealth and prestige because of her glassmakers, who contributed so much to her economy that the industry was put under absolute government control. Thousands worked behind iron bars so that trade secrets would not be divulged to other countries, but they enjoyed a station in life akin to that of nobility so long as they obeyed the rules. If they were caught attempting to escape to foreign soil, they were put to death.

The artisans in American glass plants today are, in the main, descendents of the craftsmen who came from Venice and elsewhere in Europe. The older sections of the Corning Works might have been taken out of the pages of a sixteenth-century book. There the men still use the techniques and tools of their forebears—blowing irons, forming blocks and paddles of wood, and hand shears—to make specialty products that have defied mechanical methods or have not justified installing machines because the demand for them is small. At one point, two huge, circular 16-pot furnaces furnish free-hand blowers with cherry-red to white-hot glasses for a host of purposes. These furnaces are surrounded by gatherers, ball holders, gaffers, mold boys and others busy making infrared-light bulbs and thermometer-tubing glass, pressing out signal-light reflectors and fashioning a long list of other things.

Articles in previous issues of this publication have touched on phases of the Corning Glass Works' activities, but it would take a book to deal comprehensively with all its ramifications. New glass products—surprising industrial and scientific contributions—make headlines as they emerge from the test tube and laboratory furnace and are put on production lines. All these achievements, whether attributable to Corning or other of the more than 200 glass plants in the United States, are recorded at the Glass Center. Space limitations permit the inclusion here of only a few of the industry's outstanding advances.

With regard to optical glass, it is said that America did not win her independence from Europe until 1945. That year, which marked the world's first mass output of glass of that type, Corning scientists brought to the commercial stage a continuous process of making lenses. That procedure, which replaced the standard batch method, stemmed from research stimulated by the Government's call for a stepped-up production of lenses for instruments of war. It has made it possible for the first time to form optical and ophthalmic glass blanks to the approximate size and shape of the finished product, thus eliminating reheating, molding and arduous grinding of pieces cut from large sheets of glass. Continuing its research in this field, the company next compounded glass for bifocal lenses free from the imperfections that were thought to be inherent in glass of this kind. The high

**MUSEUM OF GLASS**

The Corning Glass Center tells the story of glass from the beginning. Lighting of the cases in its corridors ranges from black to skybright to help bring out the finer qualities of the ware displayed. A few of the museum's rarest specimens are pictured at the right. The book—"L'Arte Vitraria" by Antonio Neri of Florence (1612)—is the first known publication devoted entirely to glassmaking. On it are an amphora and beads that were made in Egypt about 1500 B. C. One of two goblets remaining from the work of England's great craftsman George Ravenscroft is at the left. The dragon-stem goblet is a sixteenth-century Venetian masterpiece.

**WINDOWS FOR SUPERSONIC TEST TUNNELS**

**The knowledge and experience gained in casting the mirror for the Mt. Palomar telescope gave Corning a good start in the field of optical glass, one phase of which is the making of windows for wind-tunnel chambers in which models of aircraft are tested in streams of air having twice the velocity of sound. The picture below shows one of the disks being examined for blemishes.**

quality of modern optical glass is demonstrated in the Glass Center, where one can read a small printed card through a bar 11 feet long.

The casting of the 200-inch mirror for California's Mt. Palomar Observatory in 1934 made history. The experience gained in making that reflector, which remains the largest mass of glass ever cast, has proved to be of great aid to aeronautics. Corning now casts 1-ton windows for supersonic wind tunnels that enable scientists to study the performances of model aircraft subjected to wind velocities in the 1500-mile-an-hour range under varying conditions. In these giant lenses no flaws are tolerated that would distort photographic records of shock-wave and air-flow patterns. They are 6 inches thick to withstand the forces to which they are exposed and 52 inches in diameter to afford a full view of the object within.

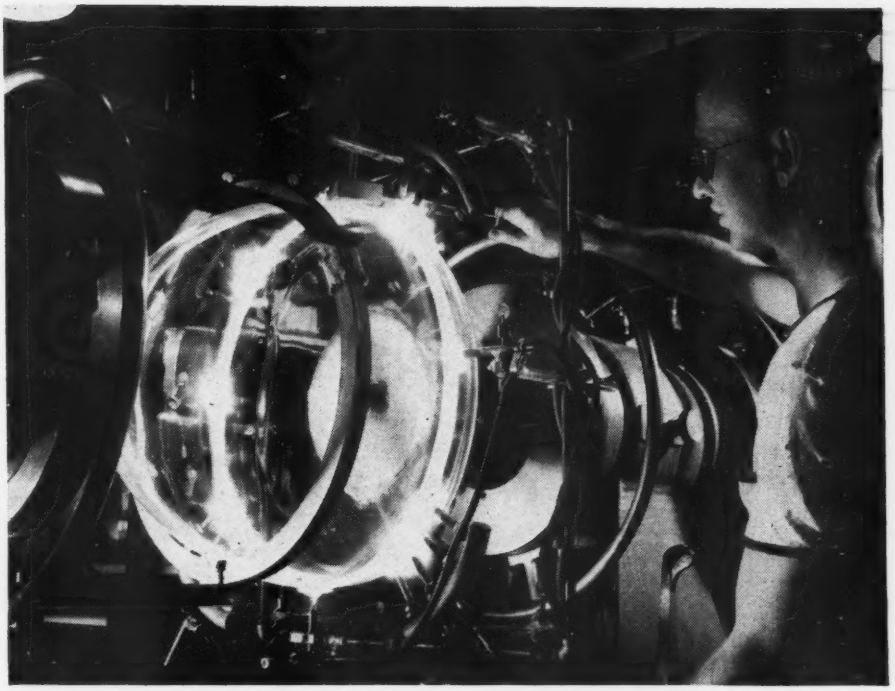
Strange as it may seem, glass is quite flexible and elastic up to the point of fracture, and for the entertainment and enlightenment of visitors, these properties are demonstrated at a booth in the Glass Center. There, by pushing a button, a coiled spring is flexed mechanically within considerable displacement limits. As a matter of fact, such a spring has actually been flexed 449,000,000 times at Corning without showing signs of fatigue. This and other qualities have resulted in a special mixture and a refined process by which the company is producing great quantities of glass ribbon. The strips can be rolled and sharply twisted, and the material possesses insulating and dielectric properties equalling those of high-grade mica. In combination with foil it is being fused into superior electrical capacitors.

The mass manufacture of television tube blanks could not have been accomplished without a combination of developments. Each blank is made up of two pressed-glass sections, a pie-plate-shaped face and a funnel-shaped back which are welded together. It was no small undertaking to devise the electrical apparatus with which to weld the parts into vacuumtight bulbs that would meet the rigid specifications of manufacturers of TV sets. The method in use is based on the principle that glass will conduct electricity at high temperatures. The edges to be bonded are preheated by gas flames until they are softened; then they are brought together and a high-frequency electric current is shot at them through the flames. The result is a homogeneous joint, formed at about 2000°F without distortion and without imparting stresses to any part of the bulb, which is as strong as the glass itself. Displays at the Center show that this means of welding permits the fabrication of glass shapes never before thought possible.

Conveying foods, drugs and corrosive industrial fluids by glass piping is not new, but in consequence of recent improvements in manufacture such lines are now being used for purposes for which they were considered unsuitable heretofore. The chemical stability of the glass that goes into pipe and fittings has been increased measurably and prevents it from contaminating foods and drugs and makes it resistant to nearly every corrosive industrial liquid and gas. The glass is likewise unusually resistant to mechanical shock, as was demonstrated when a spike was driven through oak with the heat-strengthened end of a pipe joint. Being a borosilicate glass, it has a low coefficient of expansion and therefore withstands thermal shock brought on by sharp temperature changes either of the fluid carried or from without. And in giving the material these engineering advantages none of its former properties have been lost or impaired. Unchanged is the capacity of glass piping to resist temperatures up to 250°F under normal conditions and a maximum of 450° when protected against thermal shock. It still offers continual visual inspection of the contained liquid because of its transparency and has the smooth internal walls that minimize the deposition of scale and other matter.

In 1947, Corning discovered photosensitive glass in which 3-dimensional pictures of a loved one, a prize catch or a favorite scene can be permanently ingrained. This is done by adding very small amounts of metallic compounds and sensitizers to ordinary colorless transparent glass. The resultant product is clear and sensitive to ultraviolet rays which, upon passing through a photographic negative in contact with the glass, set a latent image in and through the latter. When the glass is subjected to a temperature of about 1050°F, the submicroscopic metal particles precipitate out of solution and the image becomes visible. Ingredients can be put in the mix for colored pictures.

Further research in photosensitive glass followed, and in 1949 was produced an opal glass that is made and developed in much the same manner as the transparent glass just described. However, upon heating, the contained metal particles act as centers for the growth of opal crystals that are essentially nonmetallic, and the final design on or in the screen or negative is reproduced in the form of milky colored crystals. A wide variety of patterns can thus be grown through the glass, but the one most popular at present has clear squares or bands bounded by layers of opal crystals at prescribed angles and spacings. It is usually manufactured in sheets and used for fluorescent lamps. Light rays passing straight through the clear areas travel virtually unimpeded to the work surface, whereas those striking the layers of opal crystals are diffused and eliminate glare.



**WELDING GLASS ELECTRICALLY**

The white-hot band on the TV tube in the lathe represents the edges of its two sections as they are welded into a vacuumtight joint by electric apparatus. This development led to the mass production of these tubes, which would otherwise have had to be made by arduous, slow and expensive hand methods. Another outstanding application of this technique was the welding of 7½ miles of Pyrex glass piping in the atomic-energy plant at Oak Ridge, Tenn., by the Stone & Webster Engineering Corporation. Field fabrication of glass piping was new at that time and could not have been accomplished without the equipment and technical know-how furnished by the Corning Glass Works.

**FIRING A POT**

This picture was taken just when an optical reading was being taken of the temperature of one of the pots of a 16-pot furnace at Corning's B factory, which is still given over to freehand blowing. When a pot is nearly empty it is replaced by another containing an exactly proportioned mixture which is brought up to the working temperature specified for that particular formula and its application. That is normally done on the night shift. During the two other shifts the area is given over to the freehand blowers. Above the pot openings are ducts that deliver cool air from nearby blowers for the comfort of the workers. Between the pots are pipe lines that carry air at higher pressures to open and close molds and presses, to feed jets by which tools and glass objects are cooled, and for other purposes.

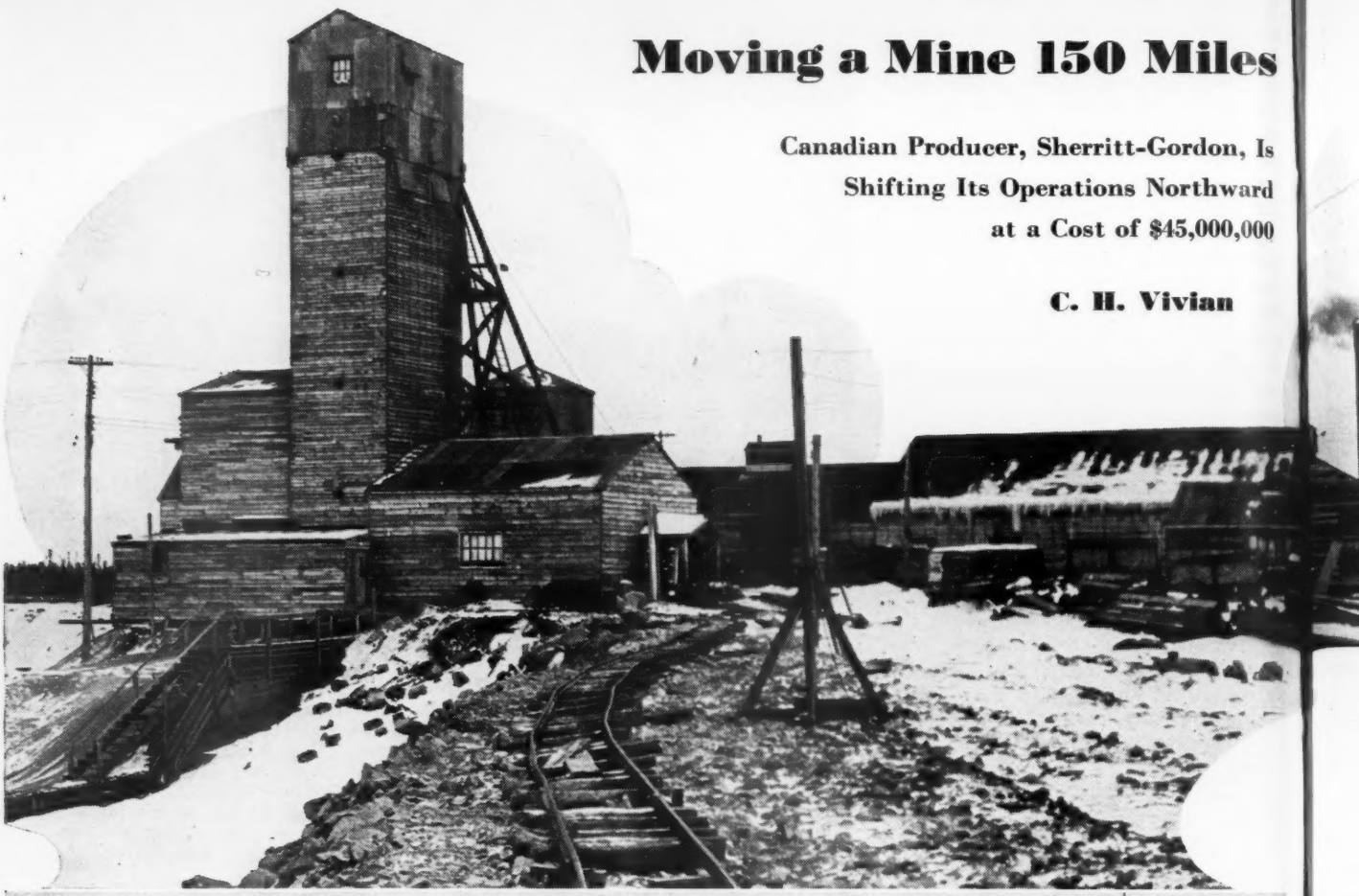
But that is not the end of the story of photosensitive glass. Last year Corning announced a special opal glass in which intricate designs can be etched with machinelike accuracy. In this case the glass is immersed in hydrofluoric acid after exposure to ultraviolet rays and heat for the growth of opal crystals. The photographic, milky opal-crystal image is about 50 times more soluble in the dilute hydrofluoric acid than are the colorless transparent areas of the glass so that square, round or hexagonal openings as small as 0.004 inch in cross section can be etched to various depths in as well as through the glass.

All these developments disprove the age-old theory that glass has physical limitations which disqualify it for other than the long-familiar applications. Today it is also an engineering material for which industrial designers have many uses because it combines durability, permanent finish and transparency or opalescence with indifference to heat, electrical stability and chemical inertness. These and other properties have been imparted to it largely by the Corning Glass Works through its years of experience and research and manufacturing facilities.

# Moving a Mine 150 Miles

## Canadian Producer, Sherritt-Gordon, Is Shifting Its Operations Northward at a Cost of $45,000,000

C. H. Vivian



A CANADIAN mining company is in the midst of a $45,000,000 moving day. Sherritt-Gordon Mines Ltd., having worked out a copper-zinc-gold-silver deposit at Sherridon, Manit., is shifting its activities 150 miles northward to Lynn Lake in the same province and opening up nickel-copper ores in virgin mining territory. The term "moving day" is used figuratively, because a transfer job of such a magnitude can no more be completed in a day than could the building of Rome. It was, in fact, begun several years ago, and will not be finished until 1953.

It is unusual if not unique for a concern of Sherritt-Gordon's size to pick up its belongings lock, stock and barrel and set them down elsewhere. It is certainly unprecedented in Canada, which is still too young as a mining nation to have worked out many large showings of ore. Some of its mining companies have abandoned properties and acquired others, but the distinguishing feature in this instance is that Sherritt-Gordon is moving its physical plant and equipment, its employees and their families, and most of the buildings in Sherridon. It is a wholesale hegira.

Never was a corporate shift made with more trouble and expense. In the beginning there was not even a road to follow, and men and supplies went in by air. Since then heavy hauling has been done in winter over a roadway that is impassable except when freezing temperatures hard-surface the miry muskeg. Overland shipments in the winter of 1950-51 totaled 9000 tons, and are expected to reach 11,000 tons this winter. A part of the moving bill will be a $15,000,000 item for extending the Canadian National Railways to Lynn Lake, a job that will not be completed until

CANADIAN NATIONAL RAILWAYS PHOTOS

**LYNN LAKE TODAY**

Like most frontier settlements, Lynn Lake is starting life a bit on the shabby side. Because all materials have to be flown in or hauled over the frozen muskeg, builders can't be choosy and have used whatever they could lay their hands on. After the rails reach the camp it will spruce up. Pictured at the top-left is the temporary headframe at A Shaft, which was sunk to open up mineral deposits and also to provide ore for a 3-year research program that was begun in 1949 and has developed a leaching process for extracting nickel and cobalt from concentrates. The other views show the town's "business" and "residential" sections.

late 1953, by which time the new mine is scheduled to be in full operation. The carrier will, consequently, be of no help to the movers, although it will be indispensable in the future for hauling in supplies and bringing out the metallic harvest for which all this effort is being expended.

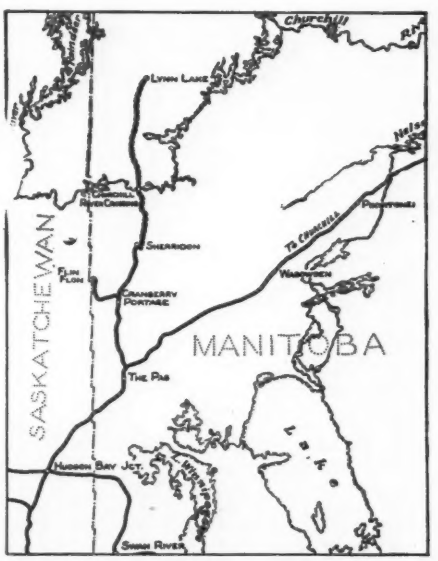
Sherritt-Gordon closed down the Sherridon Mine last September 16. For several years previously its end had been foredoomed. Diamond drilling had failed to locate additional ore bodies, and preparations were made to extract all recoverable ore and then quit. This was done in an orderly fashion, and equipment that could be put to further use or sold was brought above ground, starting at the lowest level and gradually working upward. The terminating activities had been planned so well that the mine worked right up to capacity and at a profit to the last. The final "clean up" was the removal of a huge pillar of ore that had been left in place to support buildings above it. The decision to mine it prolonged the life of the property by about three months.

Looking forward to the day when the ore shoots at Sherridon would give out, the company began a systematic search for other deposits about 1937. Geologists and prospectors combed the section to the north, but failed to find anything of a promising nature until late in 1945. In December of that year Austin McVeigh, a veteran prospector who had previously discovered what is now the Madsen gold mine at Red Lake, Ontario, found a showing of mineral where geophysicists employing a magnetometer had located several anomalies. An anomaly is an area where the magnetic pull of the earth deviates from the normal. Where the pull is above normal heavy material is indicated, and it is a likely place to look for mineralization.

The only outcropping McVeigh could find was an area of dioritic rock about the size of a tablecloth, which rose like an island in the midst of a sea of glacial drift up to 40 or 50 feet in thickness. The rock in place was lean in mineral, but some detached pieces of float resting nearby were richer. On the strength of this showing, Sherritt-Gordon flew in a diamond drill and crew and went to work. The first two holes produced cores having a nickel content on a par with the ore at the great Sudbury deposits of The International Nickel Company but were lower in copper.

The discovery set in motion a huge program of exploration to test the surrounding country. The company announced the find during the final days of the year, but withheld the exact location until it could stake additional claims. An effort was made to send in a second drilling rig and crew, but bad flying weather thwarted that. Meanwhile, with the air freight rate at fifteen cents a pound, work was begun on improving a fishermen's road from Sherridon so that equipment and supplies might be moved in overland on tractor-drawn sleds. The route was opened for travel on February 14, 1946.

Among the first men to make the trip were wood choppers to provide fuel for the drillers who had had to stop work because a small stream from which they were obtaining their water had frozen




**LOCATION MAP**

The heavy black lines represent the routes of the Canadian National Railways. The 155-mile link being built from Sherridon to Lynn Lake is indicated by a broken line.

solid. Within a short time four drills were operating from the ice-covered lake, it having been decided to explore the underwater sections in winter and leave the land areas until thaw. In preparation for future activities, a complete set of camp buildings and sufficient supplies for four or five months were hauled in before the winter breakup. Spring came early that year, and by the middle of May there was enough open water for planes to land and take off. This permitted bringing out the accumulation of cores from the drills so that some sort of an appraisal of the value of the deposits might be made.

The results proved so favorable that Sherritt-Gordon officials began thinking in terms of a big new mine. Drilling continued—many thousand feet of it with seven rigs—until it was pretty well known where there was ore and where there wasn't. To the end of 1947, it totaled 160,000 linear feet. Even then drilling didn't stop, and it is still going on both to permit making a close estimate of the extent and grade of the deposits and to obtain geological data that will be helpful in mining.

The cored samples of the underground formations show that there are at least six commercial ore bodies, apparently in the form of lenses, containing fourteen million tons of ore worth around $280,000,000 at prevailing market prices. Little exploration has been done below a depth of 1000 feet, and there may be other mineral concentrations at lower horizons or elsewhere on the company's holdings.

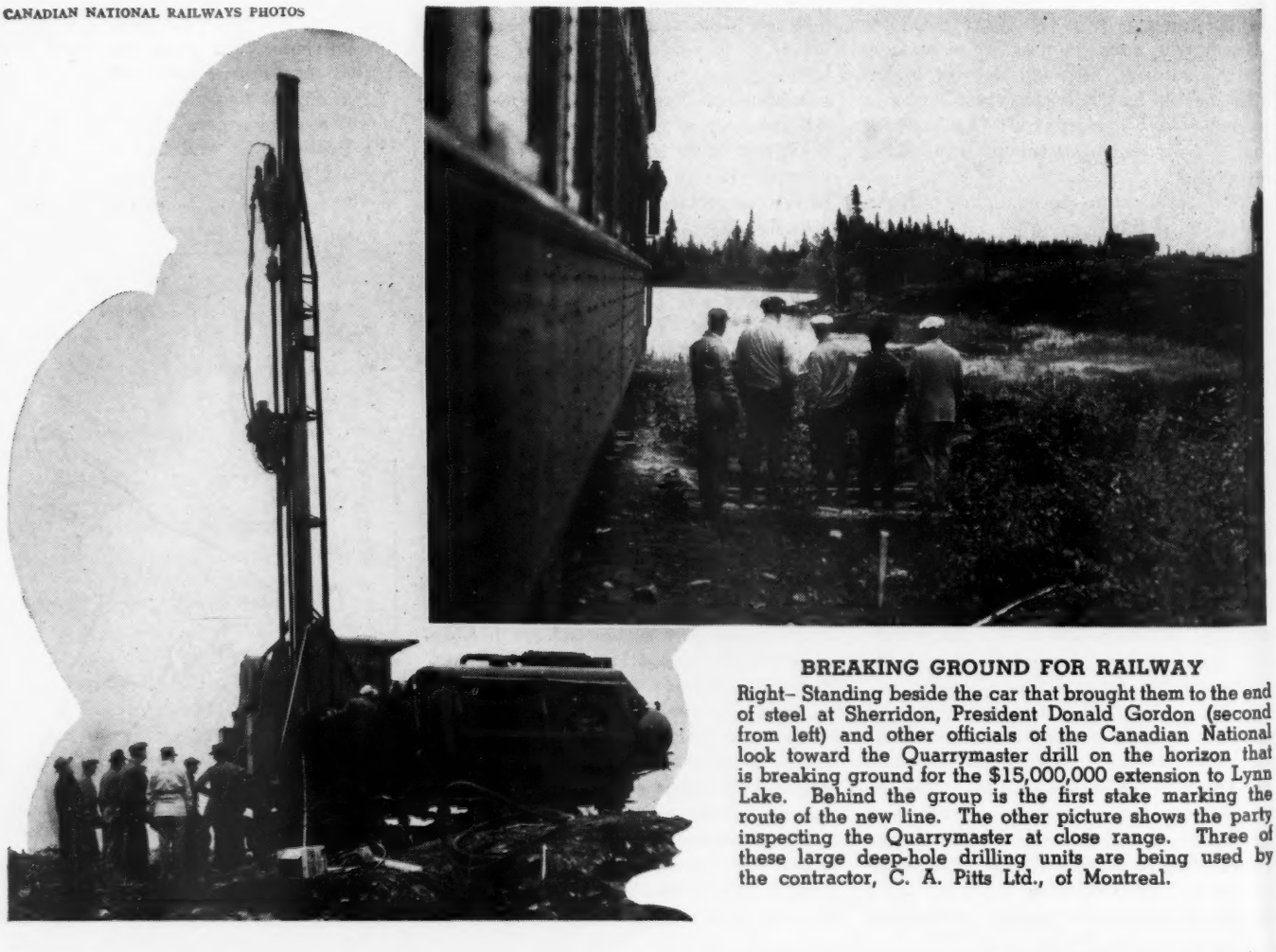
Five of the lenses, designated by the letters A, B, C, E, and Z, are grouped fairly close together and can be mined from one shaft. A sixth, called the El, is several hundred feet away. Preparations to start production by the time the railroad gets through are going ahead steadily. A 1000-foot shaft to give access to all the ore bodies but the El was completed in the summer of 1949, and since that time several levels have been opened and other development work done. A steel headframe for a shaft at the El deposit was hauled in during the winter of 1950-51.

It is planned to mine only the A and El ore bodies during the first five years, taking about 1500 tons a day from the A and 500 tons from the El. The underground is being laid out for inexpensive mining, something for which Sherritt-Gordon acquired a reputation during its former operations. Ore will be dropped by gravity to the 1000 level, crushed and conveyed by belt to the shaft for hoisting. There will be no tramming.

Research for the purpose of developing a suitable metallurgical process for reducing the nickel ore was initiated in 1949. Since the summer of that year a pilot mill at Lynn Lake has been producing concentrate for these investigations, and many tons of it have been flown to Ottawa where a staff of 45 chemists and metallurgists has been working. Two concentrates will be made in a selective flotation plant at the mine: one containing copper and the other nickel and cobalt. The former will be sent to the smelter of the Hudson Bay Mining & Smelting Company at Flin Flon, 45 miles southwest of Sherridon. The nickel-cobalt concentrate will go to a new leaching plant that will use a combination acid process originated by Dr. Frank Forward of the University of British Columbia and an ammonia process worked out by Sherritt-Gordon technicians. This treatment is designed to accomplish the same result that is obtained by The International Nickel Company with a smelter and refinery at Sudbury. The leaching works will be located somewhere in Alberta, where there is natural gas for fuel. It also must have access to large supplies of water. It is estimated that the plant will cost $17,500,000, most of which will be spent on machinery and equipment.

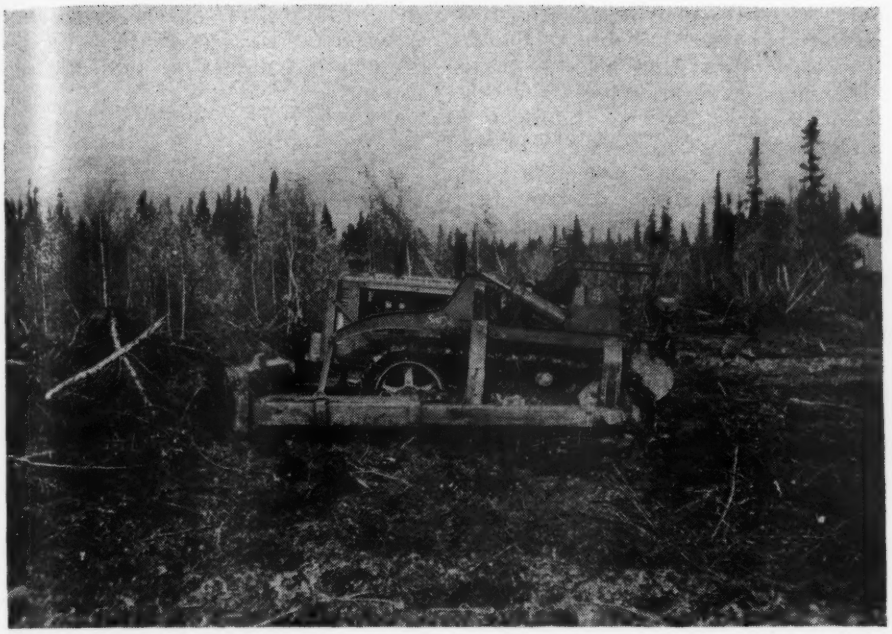
Fortunately, the ore-concentration process will differ but slightly from that practiced at Sherridon, and the existing

CANADIAN NATIONAL RAILWAYS PHOTOS



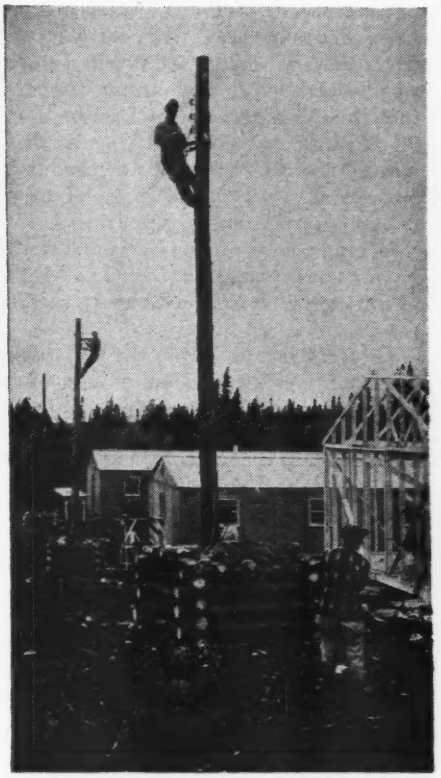
**BREAKING GROUND FOR RAILWAY**

Right– Standing beside the car that brought them to the end of steel at Sherridon, President Donald Gordon (second from left) and other officials of the Canadian National look toward the Quarrymaster drill on the horizon that is breaking ground for the $15,000,000 extension to Lynn Lake. Behind the group is the first stake marking the route of the new line. The other picture shows the party inspecting the Quarrymaster at close range. Three of these large deep-hole drilling units are being used by the contractor, C. A. Pitts Ltd., of Montreal.



**PHASES OF CONSTRUCTION**

**The railroad builders attack their job on the ground and in the air. While a bulldozer strips brush and trees from the 100-foot right-of-way, linemen string wires on poles to carry current needed for electrically operated equipment.**



CANADIAN NATIONAL RAILWAYS PHOTOS

mill will be used with only minor modifications. It has a capacity of 2000 tons of ore daily, and initial mine production will consequently be set at that figure. On that basis the annual output is estimated at 840 tons of nickel, 3414 tons of copper, and 100 tons of cobalt. The nickel and cobalt will be separated by the leaching process, which will also yield 72,000 tons of ammonium sulphate a year as a by-product. At present prices, the annual return from all products will approximate $14,000,000, of which about half is expected to be profit. The United States has contracted to take most of the nickel and all the copper and cobalt for five years.

In below-zero weather, Lynn Lake workers are now excavating and pouring concrete for building foundations. By spring, substructures will be ready for most of the permanent shops and treatment plants around both the A and the El shafts. The job of dismantling and reassembling these facilities is in the hands of Dominion Bridge Company Ltd., but moving is done by the mining company. A good share of Sherridon's houses have been freighted to their new sites, and even a church is earmarked for the trip. However, with the beginning of railroad construction and the establishment of the contractor's headquarters in Sherridon, workers and their families have been pouring into the town and occupying homes. The job of relocating some of the latter will consequently be postponed for a year or so.

Speaking of houses, a distinctive type suitable for dwelling or general utility purposes has played a big part in the Lynn Lake development. It is called the "12x28," from its floor dimensions. When Sherritt-Gordon was scratching around near Sherridon for new ore, it housed its prospectors in tents, small shacks, or whatever else was available. When the supply of these ran out, someone decided to design a structure that would serve as a home, bunkhouse or cookhouse and still be small enough to haul over bush roads. The result was the 12x28, which became popular and plentiful. When need arose for accommodations and offices at Lynn Lake, these warm, well-built, $350, 4½-ton wooden structures were the answer. In one winter 22 were constructed at Sherridon and freighted over the snow to the new camp. A family headed for Lynn Lake moved its furniture into one of the houses and sent it off. Three days later the people flew up and found the home awaiting them ready for occupancy. It had made the trip without anything in it being broken or seriously disarranged.

The town site at Lynn Lake has been cleared of brush and other growth and a road connects the A and El shaft areas. The camp will rise on sandy ground that slopes from the lake to a point 150 feet above the water. Farther back are rolling hills with light stands of spruce and jack pine. The longitude of the town is 101°, almost due north of Wichita, Kans. It is about 10 miles south of the fifty-seventh parallel, approximately in line with Juneau, Alaska, and the southern tip of Greenland. It is far enough north for the permafrost to extend down 100 feet or more in the 1000-foot A Shaft. Air sent down to ventilate the mine will have to be heated.

By official action, Manitoba has set up the local government district of Lynn Lake, with an area of 400 square miles. It will be administered by C. R. Neely, a former banker who has managed Sherridon for the mining company since 1937. Prior to that time he was mayor for six years of the Manitoba city of The Pas.

While the diversified activities at Lynn Lake are underway, a hydroelectric plant is being built 40 miles away on the Laurie River. A dam and powerhouse have been substantially completed, and the turbines, generators and other equipment are being hauled in this winter. The station will have an initial capacity of 7000 hp, and there is a second site that can be utilized if the need for more energy arises. The route for a transmission line to Lynn Lake is being cleared. The sinking of the El Shaft is awaiting the arrival of power, as the hoist is electrically operated.

The construction of the railroad presents problems similar to those that confronted the builders of the transcontinental lines 60 years ago. The section to be crossed is typical bush country, with no roads and few trails. It is a land of moss and muskeg underlain by granite and gneiss, which occasionally rise above the general level. In places there are dense growths of spruce. Almost everywhere there is water in sloughs, streams, and lakes, and in summer one needs an airplane or a canoe to go very far. For these reasons most of the construction equipment and materials must be transported in winter when the ground is firm.

There is a saying in the North that it takes a peculiar kind of engineering talent to lay out a railway in such terrain. With experience, men acquire a

sort of sixth sense that tells them to run the line here and not there. By exercising this innate judgment, they build a stable roadbed that avoids the numerous pitfalls and yet maintains such a nice balance between cut and fill as to keep costs within reason. A stretch of road like the one in question has not been constructed since the early 1930's, when the line with which it will connect was pushed across the barrens of Manitoba to Churchill, up on Hudson Bay. Significantly, Maj. J. L. Charles, who located the final 154 miles of that link, as well as hundreds of miles of other stretches on the western prairies, is now chief engineer for the Canadian National in western Canada, and it fell to his lot to direct the Sherridon-Lynn Lake surveys.

As far back as 1946, the Canadian National was aware that a new mine was perhaps in the making at Lynn Lake, and a general reconnaissance of the area was ordered. It showed that there were three possible rail routes: it could take off from the line to Churchill at a point east of Lynn Lake, or run in a general northerly direction from either Flin Flon or Sherridon. The Canadian National, of course, wanted to follow the route along which the most freight was likely to develop in the future. That is naturally a hard thing to determine in a territory that is virtually unexplored.

In 1950 the management of the railway decided to build the extension, and in January, 1951, instructed Mr. Charles to lay out the right-of-way in detail. Because of the preparatory work, it took only two weeks to select Sherridon as its starting point. On February 16 parties set out from that place to make preliminary surveys. When the spring break-up came they were stalled for a while, but as soon as the ice went out two groups of twenty men each were in the field again. The line was tentatively laid out by August and definitely located by October 10, after 236 days of elapsed time. The results of the field work were transferred to paper in the form of a map on a scale of 200 feet to the inch showing the topography along the route with contour lines representing 5-foot intervals. An accompanying annotated profile gave running particulars regarding the terrain such as "wet muskeg," "dense growth of 30-inch spruce," "solid rock," etc.

Twenty-seven contractors applied for copies of the plans and specifications, but after looking them over only five examined the territory to be traversed and only three submitted bids. The contract was awarded last August to C. A. Pitts Ltd., of Montreal. Clearing the right-of-way to a width of 100 feet was started immediately with bulldozers that strip off the brush and trees faster than the pioneer construction men would have believed possible.

Rock drilling began on September 29. For this work there is being used for the first time on any railroad job the new Ingersoll-Rand Quarrymaster drill that can put down a 5½-inch hole to a depth of as much as 70 feet. This heavy-duty machine is no stranger to the Pitts organization, because it bought and used three of the units while excavating for the Des Joachims power plant on the Ottawa River in 1950. Subsequently, it sold one of the drills and is utilizing the two others on another contract. In order to avail itself of the effectiveness of the Quarrymaster on railroad construction, the firm has rented three of them.

The difficulties experienced by the surveyors will be met in a much larger measure by the contractor, especially since he is being called upon to complete in two years a job that would normally take three. To accomplish this, he will have to adhere closely to a rigid schedule. It calls for the building of the first 56 miles to the Churchill River by the spring of 1953. The waterway must be bridged before work can be started on the final 99-mile leg from there to Lynn Lake.

To avoid a long and expensive bridge, the Churchill will be crossed at a point where it divides into three streams. This will require three steel spans with lengths of 201, 155, and 200 feet, respectively. In most places it would be possible to bridge the river at any season, but not there, because one of the spans goes over Pukatawagan Falls. Spray from the open water would freeze inches thick on the girders in winter.

As soon as the freeze-up came last fall, tractor trains began hauling supplies and equipment for camps and construction, spotting them along the line at locations where they would be needed later. Included were steel and cement for at least one of the Churchill bridges. Piles for many timber spans will have to be driven this winter, and that calls for thawing the ground with steam wherever a pile goes down. Among the materials required to complete the job will be 1½ million cubic yards of crushed rock and 700,000 cubic yards of gravel for roadbed and ballast. These are minimum figures that may have to be increased if the muskegs prove to be deeper than they are thought to be. It is not known how much usable rock will be found at accessible places along the route, and it is intended at present to ship in most of it and probably all the gravel. Although there is timber in the country to be traversed, it is not considered acceptable for ties, and 450,000 of these crosspieces will be shipped in.

The timetable calls for the completion of 15 miles of grade by early next summer and then laying rails steadily until the Churchill River is reached in the fall. With the bridges erected, the work will be pushed on, and tracklaying is scheduled to be finished by October 31, 1953. Some ballasting will still remain to be done, and the railroad will not be turned over to the dispatcher until early in 1954.

Up to last June the transfer of Sherritt-Gordon's operations had cost around

**INSPECTION PARTY**

For this pose the Canadian National Railways group, shown on a preceding page, turned around. From the left they are: J. R. McMillan, vice-president, western region; President Gordon; Maj. J. L. Charles, regional chief engineer; B. L. Daly, a director; and S. F. Dingle, vice-president of operation.

CANADIAN NATIONAL FILM BOARD PHOTOS

**LAND OF FURS, FISH AND MUSKEG**

Muskrats formerly abounded in Manitoba but were almost extinct by 1930. To restore the fur industry the government created dams and swamps, and by 1940 trapping was good again. Pictured at the lower-left are a trapper's wife and daughter perched on one of the sleds of a tractor train about to leave The Pas for the grounds to the north. At the upper-left, John Lucas, driver of one of the tractors, holds up a muskrat. A pelt is cut into four pieces: the back for best quality, sides for seconds, and the belly for low grade. Most of the fur is marketed in Winnipeg. Each winter 6000 men fishing through the ice on 40 Manitoba lakes catch more than 30 million pounds of fish worth in excess of $4,500,000. Ninety percent of the catch is sold in the United States, mainly in Chicago and New York. The view at the right shows fishermen hauling a net from a hole in the ice.

$7,000,000, all of which the company paid out of accumulated earnings. Later in the year it sold $4,400,000 worth of stock to its shareholders and to the Newmont Mining Corporation in the United States. It also issued $25,000,000 in debentures. The nearly $30,000,000 thus made available is expected to cover all expenditures necessary to get the mine and the leaching plant in operation and leave a comfortable working capital.

To build the railroad, the Canadian National is putting up $10,000,000 and the Canadian Government $4,750,000. Sixteen months after the mine starts operating, Sherritt-Gordon will begin to pay an extra freight charge of $2.65 per ton until it has shipped 1,880,000 tons, when all the money will be returned to it. In addition to Sherritt-Gordon's business, the line will get some revenue for hauling timber and pulpwood and, likely, will carry a good portion of the fish now being flown from northern Manitoba to southern markets. There are also possibilities of other mines opening up along the 155-mile stretch.

The Sherridon was a producer for 25 years, having been brought to a profitable basis by veteran Canadian prospector Robert Jowsey and American mine financier Thayer Lindsley after the claims, discovered by prospectors Shelett and Burke, had been looked over and rejected by other representatives of mining concerns. Of incidental interest in connection with its early history is the fact that the first sizable aerial shipment of freight in Canada or the United States is reputed to have been made into the property.

Anxious to explore the subsurface, Jowsey contracted with Western Airways in 1927 to fly in 30 tons of diamond-drilling equipment and 30 men from Cormet Lake, the nearest rail point, 75 miles distant. Gasoline for operating the drill engine was transported in 4-gallon tins. Jowsey was upbraided by some of his associates for paying the air line seventeen cents a pound, but he convinced them that it was cheaper than having men pack the loads in and also that it had saved a lot of valuable time. Machinery and supplies for sinking shafts and mining were subsequently hauled in during the winter by 150 teams of horses and four Holt tractors. Some of this equipment is now making its second move to Lynn Lake.

All told, the Sherridon Mine produced 181,000 tons of copper, 147,000 tons of zinc, 100,000 ounces of gold and 3,000,000 ounces of silver having a combined sales value to $58,000,000. In 1950 the company employed an average of 331 persons and had a $1,600,000 payroll. The Lynn Lake operations will require about the same number of workers.

# Blowing Damaged Cotton from Bales

COMPRESSED air is saving time and money in cleaning bales of cotton in California, which has in recent years become one of the nation's leading cotton-growing states. After the cotton is harvested, it is hauled to a gin, where the seeds are removed by mechanical action. Then the clean cotton is rather loosely packed in bales weighing approximately 500 pounds each and bound with narrow straps of light steel.

Because of the large number of bales on hand it is not economical to provide enough building space to house them until they are shipped to a compress, so they are ordinarily stored in fields adjacent to the gin. In most years this exposure does not damage them, but when an abnormally wet fall is experienced the bottoms of the bales become soaked with water and soiled through contact with the ground.

When the bales reach the compress, all the dirty cotton must be removed before it is rebaled into tighter, more compact bundles that will not take up so much room when they are shipped to market. Until wages rose so much as to make it impractical, this cleaning was done by hand. Pulling damaged cotton from the end of a bale was a tedious time-consuming process that sometimes necessitated loosening some or all the metal bands. From 25 to 30 pounds of cotton was generally plucked from each bale, and at more than 40 cents a pound that ran into considerable money.

A few years ago some of the cotton presses began experimenting with compressed air, and found that it did the job so successfully that the method has become more or less standard practice. By it, cleaning can be done much faster than was previously the case and, on an average, only about 10 pounds of cotton is lost from each bale. Moreover, it is no longer necessary to loosen the metal bands in order to remove all the contaminated cotton. A jet of compressed air directed over the surface in the proper manner blows off the thin soiled layer and does not gouge out the clean cotton underneath. Formerly, it took around twenty minutes per bale to do a poor job; now a much better job is done in from three to five minutes. The dirty cotton is not a total loss, but it does command a much lower price than clean cotton. It is collected and baled and most of it is sold for the making of paper pulp.

The compresses ordinarily use portable air compressors for this purpose, and because the work is seasonal they often rent the machines instead of buying them. A 315-cfm portable will supply enough air to operate two jets, which are ordinarily made by flattening the ends of short pieces of 5/8-inch pipe. With both nozzles in operation, the air pressure will be drawn down from 100 psi to 60 psi if the cotton is real wet and prolonged blowing is required to loosen and remove it.

At the Haslett Compress Company at the Port of Stockton up to seven men are employed during the busy season for cleaning bales. At the Calwa compress at Fresno, where the accompanying pictures were obtained, 30,000 damaged bales were cleaned in 1950 in a period of four months.

Other methods were tried prior to the introduction of air cleaning. One compress experimented with steam jets, which removed the soiled cotton but injected undesirable moisture into the bale. Following up the jet idea, compressed air was tried and proved satisfactory from the start. It saves the cotton grower money because he loses less of the bale than he formerly did, and he also gets a smaller bill for cleaning because it takes less time to do the job. The compress likewise gains: it can process more bales each day and handle them easier and quicker because their binding bands do not have to be disturbed.

**INDOOR SNOWSTORM**

Removing soiled cotton from bales with blowguns at Calwa compress, Fresno, Calif. The air, at 100 psi pressure, is supplied by the Ingersoll-Rand 315-cfm portable compressor at the right.

# This and That

**Short of Engineers? Try Beavers**

The beaver has acquired a well-earned reputation as a dam builder par excellence. With only sticks and mud as materials, and teeth, paws and tail as tools, he puts together structures that hold water well, withstand freshets and resist anything short of dynamite when man seeks to destroy them. That the animal doesn't depend solely on instinct or good luck to achieve these results is indicated by an episode reported recently in the daily press. Seven beavers were trapped in the Canadian Province of Manitoba, moved elsewhere and closely watched. They immediately set forth on a surveying expedition to locate a suitable dam site. Collectively, they traveled well over 100 miles of streams, lakes and marshes. Then they began work less than 20 feet from a stake engineers had driven a year before to mark the location of a control dam.

* * *

**Tinless Tin Cans**

The day will perhaps come when the so-called tin can will contain no tin, of which mighty little is used now. At least that is one of the goals of American Can Company, world's largest manufacturer of metal containers. Today's can is made of steel sheet with an extremely thin coating of tin. Each time we have a war and tin imports are curtailed, the film of tin becomes thinner. For certain uses, lacquer has been substituted for it. Now the company has announced that it will place greater emphasis on research with the eventual elimination of tin as the major objective. To facilitate the movement, a special laboratory will be set up at Maywood, Ill., and it will act in conjunction with established research work that has been conducted at three other points for many years.

* * *

**Who-o-osh, She Went Thataway**

In January we presented a scheme for a pneumatic freight-transportation system that was advocated by Albert Brisbane in 1872. Except that Brisbane proposed to use hollow metal spheres as carriers, his plan was almost identical with the familiar department-store pneumatic-tube system but on a much bigger scale. Brisbane was not the only one to suggest moving trains by suction. The Beach subway, an experimental section of which was built under lower Broadway in New York City about 75 years ago, was designed to operate by exhausting air from the tube in front of the cars, which ran on rails.

Nor does the idea of pneumatic transit belong solely to the past. Within recent months, Col. Sydney H. Bingham, chairman of New York City's Board of Transportation, envisioned a time when private subway tubes would run from home basements to master networks connecting all parts of the city. In this dream system travelers would be whisked through tubes in their individual push-button-controlled vehicles at high rates of speed by "compressed air of great efficiency, or some other jet arrangement without objectionable or poisonous products." Safety in transit would be assured by electronic controls designed to keep the cars separated.

The foregoing discussion reminds us that Dr. Irving Langmuir, Nobel-prize-winning electric wizard, was bold enough to suggest to a New York audience in 1943 that in a high-vacuum tunnel vehicles might travel from coast to coast in an hour. With air resistance and friction virtually eliminated, speeds of from 2000 to 5000 miles per hour would be possible, he declared.

* * *

**New Tubes Are Air Misers**

A pneumatic-tire inner tube that will hold its initial inflation pressure for from twelve to eighteen months has been developed by The B. F. Goodrich Company for service on coal-mine shuttle cars and, perhaps, on low-platform trailers, lift trucks and similar vehicles. The new tube has walls twice as thick as its predecessors and is made of butyl rubber, which retains air better than any other kind of rubber known. The valve cap can be removed only by authorized persons, as a special key is required for the purpose. In addition to saving the time it now takes to inflate such tires weekly, it is expected that the special tubes will eliminate the destruction of tires that now fail prematurely because they are called upon to bear too heavy a load while underinflated. The resultant flexing of the walls causes breaks. Goodrich engineers say this happens often because air compressors are not available in mines for periodic inflation.

* * *

**How They Talk in Washington**

Every industry develops a language of its own, but in the past two decades the Government has done pretty well along this line. Official Washington has gone in strongly for initials, but it has also come up with some surprising words, a few of which are so unintelligible to the average person that the term gobbledegook was invented to describe them. In a different category is the jargon government employees use when discussing the activities of their departments. In the course of an address *On Being a Public Official*, Secretary of Commerce Charles Sawyer mentioned this lush growth of verbiage and called it "one

"That will teach him not to lie down on the job."

of the amazing things one learns about official life in Washington."

"You don't refer to your office—you refer to your 'shop' ", reported Mr. Sawyer. "You do this in *your* shop—I do this in *my* shop. You don't delay something which you think should not be done—you 'drag your feet.' You don't postpone or slow up a program—you 'phase it out.' You don't deal with this matter under a certain description—you handle it within a certain 'framework,' and everything, of course, follows a certain 'directive.' You don't refer to a mistake in timing or a discrepancy between the objective and the accomplishment—you talk about 'slippage' or 'a short fall.' You don't say there isn't enough of something to go around—you say it is 'in short supply.' You don't appoint a group to look into a certain problem—you employ a 'task force.' You don't refer to the matter at hand as a specific problem—you refer to the assignment as an 'ad hoc' detail. You don't conclude or end a job—you 'finalize' it."

★ ★ ★

**Air Aids Handling of Grain**

On its way from grower to user, grain often travels a long distance and is handled several times. The method by which that is done varies with conditions, the choice of equipment depending in most instances upon the quantity to be transferred per hour or day and the availability and cost of labor.

The work of unloading bulk grain from railroad cars into elevators is done by power shovels, air-suction systems or car-dumping mechanisms. Either of the first two mentioned requires two men in a car and will empty, on an average, two 50-ton cars an hour. Car dumpers, which will handle gross loads up to 105 tons, have higher capacities.

Air suction is probably the best method for unloading ships, according to a writer in *Shipping Register and Shipbuilder*, a Canadian publication. The pneumatic equipment is flexible enough to be suitable for well-nigh any type of vessel, and the ship's own gear can be utilized, where desired, for handling the big hoses in the holds. Individual suction units having capacities up to 6000 bushels per hour are in service, and several of them can be operated at the same time by using different hatches.

Conveyor belts with a maximum capacity of 36,000 bushels an hour normally move grain around in as well as discharge it from terminal elevators. However, pneumatic equipment plays an important part in cleaning the grain and as a safeguard against dust accumulations that might cause disastrous explosions. Oftentimes the grain is cleaned by passing it through screens served by exhaust systems in which suction is induced by means of aspirators and streams of compressed air. In addition, suction systems collect dust at all points where it might otherwise be liberated to the atmosphere, and many elevators are equipped with magnets to remove tramp iron that might create dangerous sparks.

For transferring grain from trucks to river barges or railroad cars, a portable pneumatic system called the Grain-Vayor has been developed by the Myers-Sherman Company, of Streator, Ill. It was introduced last September and proved so successful that a new concern, the River-Rail Grain Corporation, was formed to make use of it for handling grain on a contract basis. In the original tests, grain was carried from trucks to barges at the rate of 3000 bushels per hour. The conveyor operates by suction induced by a fan driven by a 50-hp gasoline engine.

# THE MUQUIS

## —*they come from a long line of mine haunters*

THE poem on the following page was written by Virginia C. Holmgren, the wife of an Ingersoll-Rand Company salesman in South America and the author of more than a dozen books for children. In reply to our questions about muquis, she wrote:

Muquis (moo-kees) are the traditional 'gremlins,' the little mischief-makers who live deep underground in the Peruvian Andes. They resent the invasion of the earth-dwellers who come to take away their ore, and so they vent their spite with all sorts of tricks—obscene and otherwise—on the miners. If anything goes wrong underground, from falling rocks to cave-ins and floods, the muquis are blamed, but it is a bold and reckless miner indeed that dares to curse them aloud. Many a man has dodged a falling rock and turned in time to see—he says—the tip of a red beard whisking out of sight or a mischievous face with pointed elfin ears leering from behind a toppled ore car.

A little research reveals that muquis are modern conceptions of the spirits that have long been associated with mines. All stem from the fairies, described as "a race of supernatural beings who magically intermeddle in human affairs." There was a theory in ancient times that fairies were the mental images of pigmy people that dwelt in subterranean earth houses.

Agricola, first writer of consequence on mining, told of the demons and gnomes that inhabited underground passages in Saxony. The belief in them was so general among miners that the author apparently fully accepted it. In a footnote in the translation of Agricola's *De Re Metallica* (1556) by Herbert Hoover, he wrote in 1912:

The German miners were not alone in such beliefs, for miners generally accepted them. Even today the faith in 'knockers' has not entirely disappeared from Cornwall. Neither the sea nor the forest so lends itself to the substantiation of the supernatural as does the mine. The dead darkness, in which the miners' lamps serve only to distort every shape, the uncanny noises of restless rocks whose support has been undermined, the approach of death and danger without warning, the sudden vanishing or discovery of good fortune, all yield a thousand corroborations to minds long steeped in ignorance and prepared for the miraculous through religious teaching.

The Germans had their evil as well as their benign gnomes. The demons were called *kobelts*, which was the name for Agricola's "corrosive material," probably arsenical cobalt. Because it injured their hands and feet, the miners connected it with the goblins or used the term as an epithet, and finally it became associated with certain minerals. From it has come our word cobalt. Agricola said of the *kobelts:*

In some of our mines . . . there are . . . pernicious pests. These are demons of ferocious aspect . . . . Demons of this kind are expelled and put to flight by prayer and fasting . . . .

Then there are the gentle kind, which the Germans as well as the Greeks call *cobalos*, because they mimic men. They appear to laugh with glee and pretend to do much, but really do nothing. They are called little miners because of their dwarfish stature, which is about two feet . . . . They idle about in the shafts and tunnels . . . although they pretend to be busy in all kinds of labor, sometimes digging ore and sometimes putting into baskets that which has been dug. Sometimes they throw pebbles at the workmen, but they rarely injure them unless the workmen first ridicule or curse them . . . . The mining gnomes are especially active in the workings where metal has already been found, or where there are hopes of discovering it, because of which they do not discourage the miners, but on the contrary stimulate them and cause them to labor more vigorously.

The nearest approach to spirit miners in this country are the *diablos* or devils that are conjured up by some of the miners in the Southwest who are of Indian and Spanish descent. Their superstition is a mixture of religious and pagan beliefs. They have shrines and crosses both inside and outside the workings and visit them regularly. This is their religious side; the devils they occasionally report seeing underground constitute the pagan side.

(See Preceding Page)

# Psst! The Muquis!

**Virginia Holmgren**

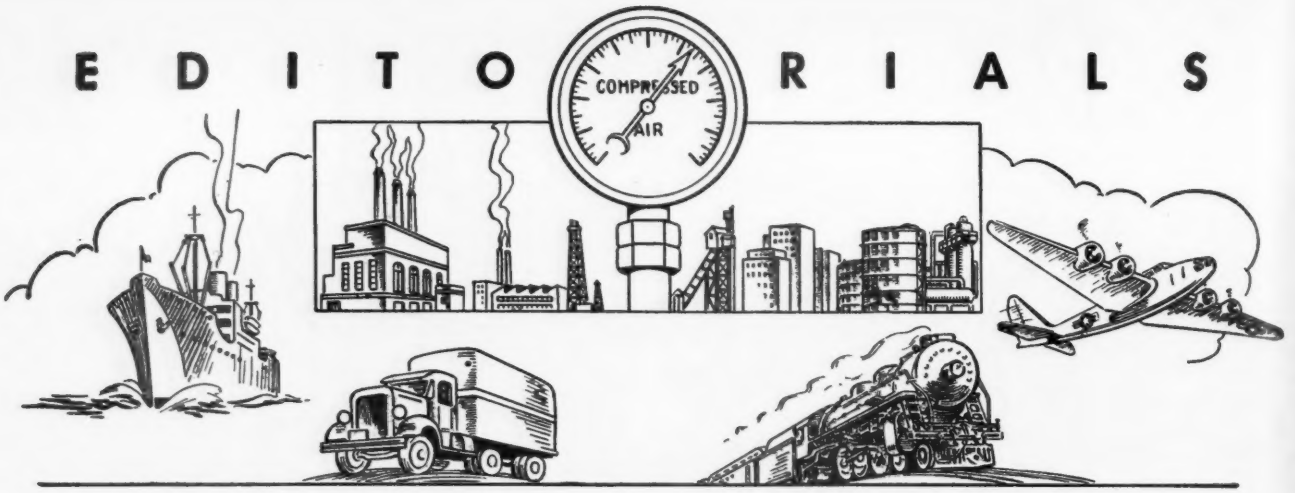
*You can talk about your gremlins*
*And your tommy-knockers, too;*
*You can talk about your gnomes and elves and such,*
*But when it comes to mischief,*
*Downright double-dirty mischief,*
*There's not one of them that's done so very much.*

*Who's to blame for that big cave-in?*
*Who just set the shaft afire?*
*Who jammed up the chute and lost our tonnage rate?*
*Who flooded out the crosscut?*
*Dropped the cage into the sump?*
*And sent the motor crashing through the gate?*

*It's the muquis! It's the muquis!*
*You can bet your bottom rock*
*When there's trouble in the mine that they're to blame.*
*Little guys with long red beards,*
*Long red noses, pointed ears—*
*Cross your fingers if you dare to speak their name!*

Drawings by Andrew Svachak

# EDITORIALS




## THE BIT THAT MADE GOOD

PROBABLY no other rock-drilling accessory ever won friends as quickly as the tungsten-carbide-insert bit. Although it was introduced in America only six years ago, it has already gained a commanding position in both mining and construction. Some enthusiasts go so far as to predict that the use of steel bits will eventually be discontinued.

Acceptance of the new product was promoted by the fact that detachable drill bits had already become well established. They represented a revolutionary development when they were first offered to the trade twenty years ago, and met the natural resistance that confronts any new idea. By 1940, however, they were doing the bulk of the world's drilling. The tungsten-carbide-insert bit, being of the same shape and general appearance as the conventional steel bit, wasn't looked upon with the suspicion with which the earlier innovation was greeted. But it did have to surmount the obstacle of much higher price. Despite that, though, it is actually the most economical tool so far devised for cutting rock, and thereon rests its success.

It has been little more than ten years since word filtered out of Germany regarding a new bit faced with an ultra-hard substance called Widia. American drill manufacturers tested a few of the bits and weren't impressed. They broke under the impact of repetitive blows from our high-power drills. Then somebody realized that they had been designed for the smaller, less powerful European drills.

When larger, sturdier inserts were made and applied to our accepted 4-point bits, as against the chisel type used abroad, they didn't break so easily. But they did break, and a lot had to be learned about how to make the inserts less brittle and how to do a better job of brazing them in the slots of steel bits. Once these troubles were remedied, the new bits were put on the market and were soon selling like the proverbial hot cakes. Now a spokesman for Ingersoll-Rand Company ventures the opinion that 70 percent of the firm's customers have tried its Carset insert bit. It is a foregone conclusion that the remaining 30 percent will give it a test, and if previous reactions are a criterion, most of them will join the Carset brigade.

Rarely is something developed in the rock-drilling field that permits a salesman to promise prospective customers that it will double drilling speed, reduce drill air consumption by 40 percent, cut maintenance and powder costs 30 percent each, and drill 300 feet or more in rock of average hardness before becoming too worn for further use. In this case, however, the article offered lives up to the glowing accounts, and that, of course, explains its almost unanimous acceptance.

## THE FRENCH LOOK AT US

EUROPEAN industrialists who were brought over here with the hope that they might benefit by observing how we do things have formed some definite opinions regarding what makes our industrial machine tick. Some shoe manufacturers from France wrote a report that does not entirely follow the usual pattern. For example, the conclusion was reached that the secret of American productivity is not to be found primarily in our machines. It was brought out, in fact, that our tools and mechanical setups for making shoes are not radically different from those in France. But American productivity, measured in purchasing power, is four times that of the French, and is paid for accordingly. This means that the average French shoe-factory employee with an hourly wage of 30 cents has to put in 60 hours to pay for a pair of shoes a Yankee worker can earn in thirteen hours at his hourly pay of $1.50.

The French say the difference is mainly one of state of mind, American workers being more productivity-minded than the French. Back of this, they say, is the way in which wage earners are regarded here; their social standing, so to speak. The French marveled at the respect with which our workers are treated and that they are always identified by name instead of remaining anonymous. They noted the absence of "class" feeling and of inferiority complexes, circumstances that are explained by the fact that every American has a chance to be promoted or start his own business, and perhaps even attain wealth.

Another reason for American industrial progress, the French say, is the acceptance by everybody of the axiom that "time is money." The report states that "the whole American industrial history decisively confirms that whenever time is saved, it means that everyone will receive more money. Perhaps it may be said that this axiom is the most condensed manner of expressing the idea of productivity. In the final analysis, if it is admitted that money means increased purchasing power, the search for ways to save time is the key to productivity and to the road it opens."

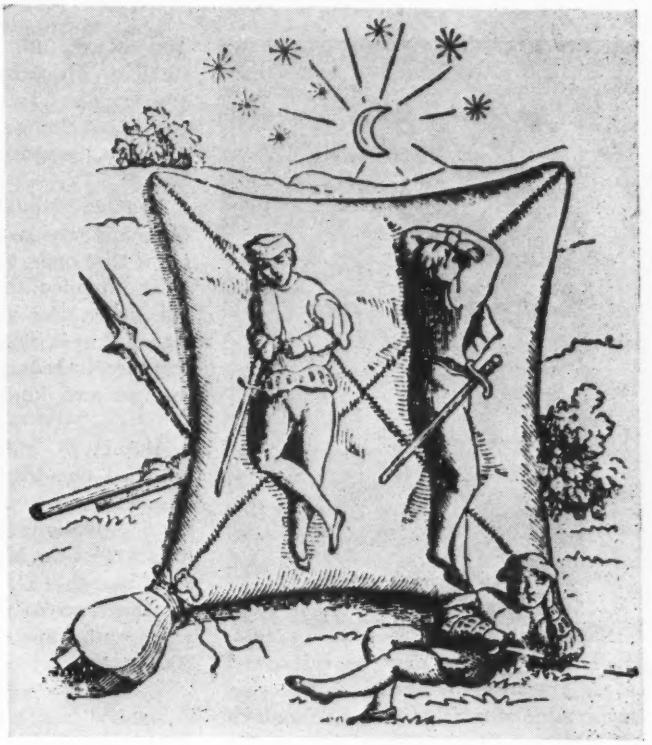
## THE DISTAFF SIDE

HIGH-SCHOOL girls apparently have been reading about the shortage of engineering graduates and decided to do something about it. Clifford Evanson, head of a Chicago engineering firm, predicts that enrollment of women in technical colleges will increase in 1952.

The idea of women technologists is not new, even though the profession has always been dominated by men. Nor is there any sound reason why women can't handle run-of-the-mill engineering assignments.

Tau Beta Pi, collegiate engineering scholarship fraternity, has made a concession in awarding special badges to 124 "lady" engineers and will, it is believed, soon grant women full membership privileges. Should the paucity of he-men graduates be prolonged, the distaff side of the race may well take over many of them. If the trend continues, makers of slide rules and other engineering office tools will perhaps add fashion designers to their staffs.

# Nothing New About Pneumatic Mattresses



**HELIOGABALUS VS GOODRICH**

**Here is evidence that the bed of the campaigning doughboy was just as soft in third-century Rome as it is in twentieth-century Korea. Take the pup tent and snow out of the modern picture and substitute the moon and summer foliage and the two scenes would not differ greatly, except for the bellows. Incredibly, it's a part of the ancient instead of the modern bed. The bellows was, of course, the Roman version of an air compressor.**

THE accompanying pictures lend truth to the saying that there's nothing new under the sun. In this instance we might add "under the moon," for we notice that the lunar disk is much in evidence in one of the illustrations.

Here we see two types of pneumatic mattresses that were designed for the use of soldiers in the field. Although identical in principle, they were conceived seventeen centuries apart. Those being modeled by the G.I.'s were just announced by The B.F. Goodrich Company, which is making them for our armed forces. The other one was regular equipment of the legionaries of Heliogabalus, a Roman emperor who died in the year 222. The sketch appeared originally in a fourth-century book on military affairs by Flavius Vegetius Rematus and was reproduced in our fiftieth anniversary edition in March, 1946.

The Goodrich mattress is made of rubber and nylon, neither of which was available to Heliogabalus. It weighs 3 pounds and can, when deflated, be folded into a flat packet about 15 inches square for stowing in a soldier's pack. We do not know what materials the Romans used, but the bag appears to have been made of hides sewn together. The mattress obviously weighed more than its modern counterpart, for it was large enough to accommodate two sleepers with plenty of room to spare. In an era *sans* zippers, Scotch tape and other modern conveniences, it is not apparent how the seams were made airtight.

In one respect the ancient air bed was superior to the 1952 model. It will be noticed that there is a bellows at the lower left-hand corner for inflating it, whereas the American soldiers must rely on their own lungs.

It may well be that Heliogabalus was the first person to utilize compressed air for human comfort. He furnished inflated cushions for his guests to recline on at banquets and sometimes suddenly let the air out of them to amuse himself, so it is recorded. He must have been the original compressed-air prankster. Possibly, he was popular with his troops because of the air-mattress idea. In fact, they staged an insurrection that landed him on the throne, where he ruled as Marcus Aurelius Antoninus. But he lived such a dissolute life that the people turned against him and put him to death after a reign of not quite four years.

## MAN-MADE GRAVEL

ACCORDING to a recent announcement from Cornell University, two members of its staff—professors Benjamin K. Hough, of the School of Civil Engineering, and Julian C. Smith, of the School of Chemical and Metallurgical Engineering—have discovered a process by which mud, sand, or clay can be converted into gravel suitable for roadbuilding and other purposes. The research that led to the development was sponsored by the Corps of Engineers, U. S. Army.

One of the ingredients of the new material is sulphite liquor, a waste product of the papermaking industry for which chemists have long been trying to find a market. Mixed with earth or sand and some chromium and sodium or potassium, the mass is fused in a briquetting machine into pieces a little bigger than a dog biscuit. These are reduced in size by passing them through a crusher. It is reported that the material showed no signs of deterioration after a 6-month period underwater and stood up well under freezing and thawing. The man-made gravel is not economical, but promises to be useful for roadbuilding in regions where Nature's product is scarce.

Tests have indicated that the chrome-sulphite liquor mixture is also a good soil stabilizer. It will penetrate a sandy surface to a depth of several inches, thus changing it into a stiff, rubbery mass that will support aircraft or other heavy vehicles.

# Industrial Notes

Plants using quantities of uniform, fitted hose lengths may be interested in an air-powered ferrule contracting machine announced by A. Schrader's Son. Mounted on a sturdy base, it can be used anywhere within convenient reach of a shop air line and is controlled by a foot valve, leaving both the operator's hands free to insert and remove the work. Known as No. 1765, the bench-type unit is said to do a neat, airtight job consistently without tiring the worker. Interchangeable dies permit quick change in setup from one size ferrule to another.

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Leopold Marsteller, a masseur of Bonn, Germany, has devised a massaging machine that operates with compressed air. It is intended to be used as a health aid rather than a beautician's tool. He claims that it increases blood circulation and thereby reduces pain caused by rheumatism and kindred ailments.

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Aluminum Industries, Inc., has announced an addition to its line of Permite membrane compounds for curing concrete. Designated as Permite W-95, it is a fast-drying spray-on compound that is said to exceed the most rigid specifications of the U. S. Army Engineers and state codes. A gallon seals 200 square feet of horizontal surface.

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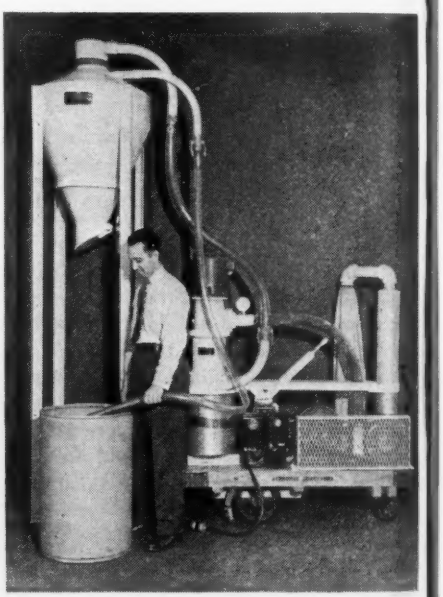
For the dustless transfer of powdered or granular materials in industrial plants, Airborne Conveyors Corporation has developed the mobile unit shown in the accompanying illustration. Completely self-contained, it serves to empty shipping containers, to replenish bins and hoppers feeding powdered resins to molding and injection presses, to deliver foods from mixers, blenders and other processing equipment to filling and weighing machines for packaging and to perform many similar services. In loading the overhead receiver of the conveyor, air entering the suction line with the bulk material flows through a cyclone on top of the unit to extract the solids, which drop into the hopper while the air goes through a hose to a centrifugal separator for the removal of any remaining particles, which fall into a collector underneath. The air stream then passes through a suction blower and a filter bag for final cleaning. The size of the receiver depends upon service requirements, but usually has a volume of 6 cubic feet. The gate at the bottom can be manually opened and closed or set for automatic operation. In the latter case the material feeds by gravity until



the hopper is empty, the gate closing the instant the positive rotary blower is started. The latter is driven through V-belt by a 5-hp motor. Loading speed depends upon the material being handled and the distance it has to be elevated. Granulated sugar, for example, entering the receiver at a point 9 feet above floor level, as in the case of the unit shown, can be conveyed at the rate of 150 pounds a minute and wheat flour, which does not flow freely, at about 100 pounds a minute.

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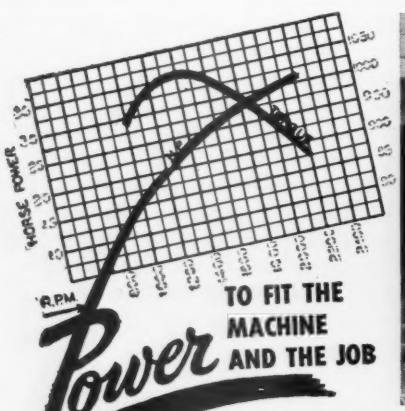
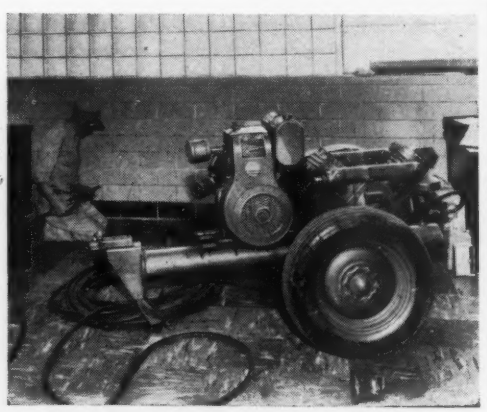
Hydrair is the name of an unusual drilling device that is making its initial appearance at the American Society of Tool Engineers' show held this month in Chicago, Ill. A development of The Bellows Company, it is an electrically controlled, air-powered tool with the feed

TO FIT THE MACHINE AND THE JOB

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The search for full-rated power that's dependable ends almost always with Wisconsin Engines . . . *first choice* everywhere, 3 to 30 hp. For example, every Wisconsin Engine crankshaft rides at both ends on tapered roller bearings, reducing the chance of bearing failure. Also, Wisconsin Engine magnetos mount on the OUTSIDE for easy servicing, but most important each magneto is equipped with an impulse coupling for quick starts in any weather. Steady running is assured, too, because of fool-proof air-cooling, summer and winter. Follow the lead of many who say, "Wisconsin Engine Power fits the machine and job." And, write today for "Power Magic" covering all 4-cycle single-cylinder, 2-cylinder and V-type 4-cylinder models, 3 to 30 hp.

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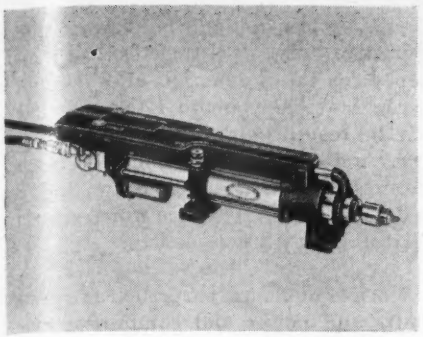

rate under hydraulic control. The spindle is advanced and retracted quickly by a Bellows air cylinder with a built-in Electroaire valve, and the feed rate is adjustable from 0 to 200 inches per minute with air at 90 psi by a Hydro-Check, another company product. The unit has a speed range of from 500 to 17,000 rpm (rated free speed of spindle 2800 rpm) making it suitable for drilling ¼-inch holes to a maximum depth of 4 inches in a wide range of materials.

---

Controlled entirely by air cylinders and valves, Lipe-Rollway Corporation's new fully automatic magazine-loaded bar feed for Brown & Sharpe automatic screw machines is said to increase production from 20 to 60 percent. The unit is relatively easy to operate, and it takes only five to fifteen minutes to change from one job to another of different stock diameter and length. Time required to eject end of bar and to restock machine is four seconds. The magazine has a capacity ranging from nineteen bars of ⅝-inch round to 96 bars of ⅛-inch diameter and needs only occasional loading. Variations in bar length up to 2 feet do not affect the operation of the unit. Feed cylinder uses air at 18 to 35 psi, but no air is admitted into the feed tube. Four models are available.

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Chemically treated wood fibers prevent the loss of expensive mud used in drilling oil wells, according to a report from the petroleum industry. Mixed with the mud, they expand about six times their original size, caking porous walls and filling cracks that would permit the mud, that serves as a lubricant, to escape as the drill descends.

---

Three services in one are provided by a new process that is said to clean, derust and prevent rerusting of steel, cast and malleable iron and iron alloys. The metal acts as the cathode in a solution of Compound No. 134—an alkaline powder—supplied by Enthone, Inc. The metal remains in the bath from a few seconds to several minutes, depending upon its surface condition and the density of the current (d-c). Zinc can be added to the solution in the steel tank to clean, pickle and give products a protective plating in one operation.

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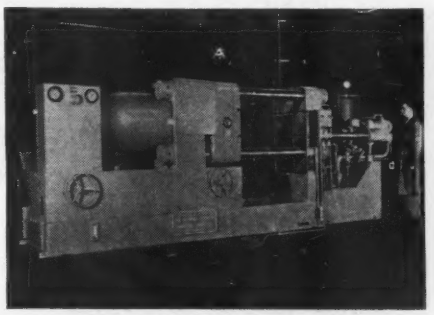
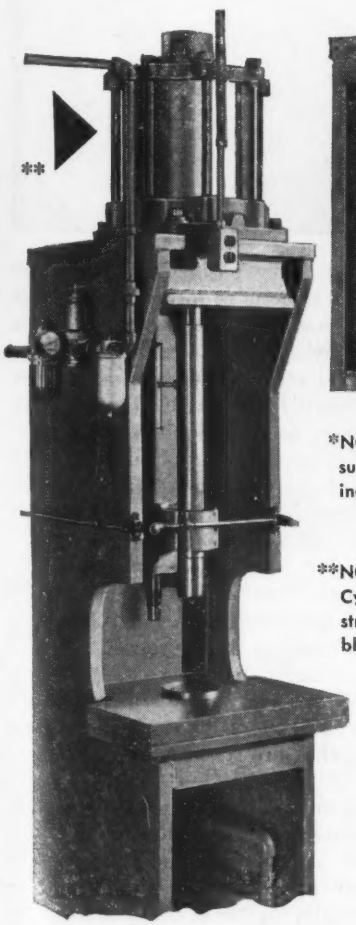
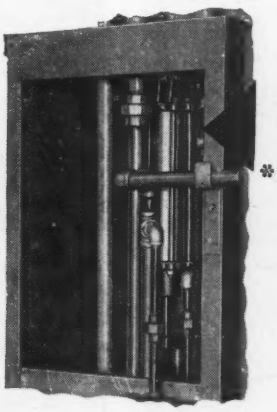
Injection speeds up to 400 feet per minute are claimed by The Hydraulic Press Manufacturing Company for its new Model 400-AB die caster and are attributed to a built-in nitrogen accumulator system. In operation, hydraulic fluid under pressure from a variable-displacement pump forces the injection ram backward and compresses the nitrogen gas in the accumulator bottle,



which is connected directly to the double-acting injection cylinder. By-passing the hydraulic fluid from the pump and releasing that in the forward end of the injection cylinder permit the nitrogen to expand and force the ram forward at a rapid rate, the speed being reg-



*NOPAK Model "E" Cylinder supplies clamping or holding power for work-piece.

**NOPAK Model "D" 12"x8" Cylinder provides power stroke for "squeeze assembly" operation.

# PRESS MOVEMENTS
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# NOPAK CYLINDERS

**Throughout industry, a variety of vital press movements are powered by NOPAK Cylinders, both air and hydraulic. For example, you'll find them on arbor presses, kick presses, punch presses, drill presses, baling presses, assembling presses, forming presses, power shears, power brakes, clamping devices, and similar equipment. NOPAK Valves control the cylinder movement.**

**If you build presses, there is probably a NOPAK Cylinder that's *just right* for your needs. Perhaps there are mechanically or manually operated presses in your plant which could be powered by air or hydraulic NOPAK Cylinders, and controlled by NOPAK Valves, to save valuable time, eliminate needless manual effort, speed up production.**

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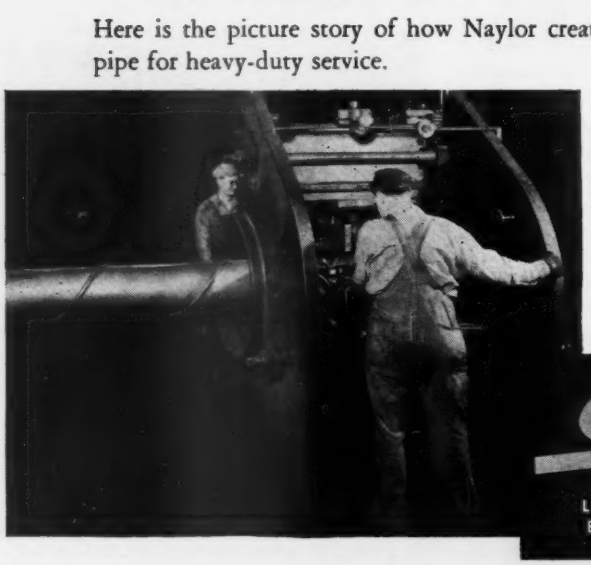
Refer to Sweet's File for Product Designers or write for Bulletin SW-1

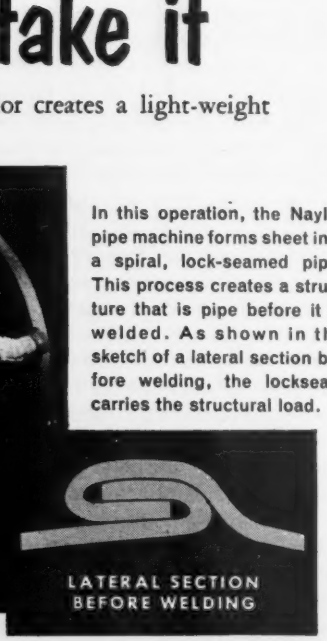
NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

# How NAYLOR Light-weight Pipe is built to take it

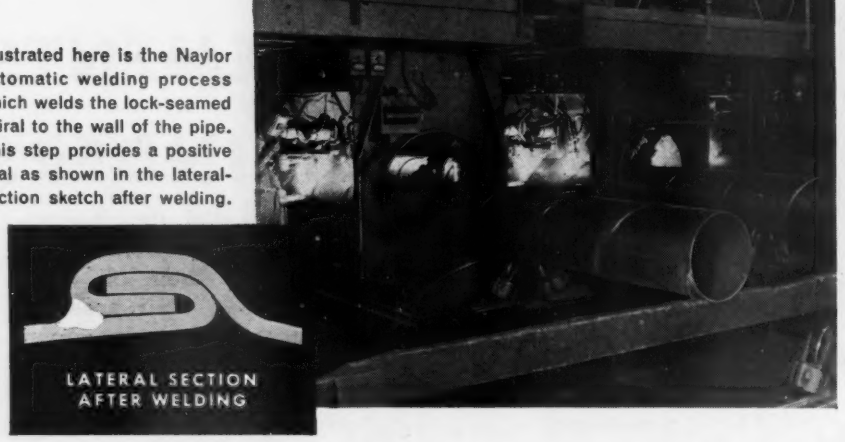
Here is the picture story of how Naylor creates a light-weight pipe for heavy-duty service.



In this operation, the Naylor pipe machine forms sheet into a spiral, lock-seamed pipe. This process creates a structure that is pipe before it is welded. As shown in the sketch of a lateral section before welding, the lockseam carries the structural load.




Illustrated here is the Naylor automatic welding process which welds the lock-seamed spiral to the wall of the pipe. This step provides a positive seal as shown in the lateral-section sketch after welding.




Because the lockseam carries the load and the weld is relieved of any strain, Naylor pipe provides the practical answer for lines that must stand up in rugged service in the mining field.

**Write for Bulletin No. 507**

**Naylor Pipe Company**
*1245 E. 92nd St., Chicago 19, Ill.*
*New York Office:*
*350 Madison Ave., New York 17, N.Y.*


ulated by controlling the flow of the hydraulic fluid. The machine was designed for the production of aluminum castings weighing up to 12 pounds but can be readily adapted for die-casting brass and magnesium. It includes such features as a hydraulic ejector and a hydroelectric safety device which guards against premature injection.

---

Worn or undersize parts such as crankshafts and power and compressor cylinders can be built up to their required size by an electrolytic iron-plating process developed by Van der Horst Corporation of America. The metal, known as Vanderloy M, can be applied to a thickness of ¼ inch or more, and the bond between it and the base metal is said to be indestructible. The deposit is machinable with high-speed steel cutters and can be ground or honed. Temperature of plating bath is low enough to permit masking with wax.

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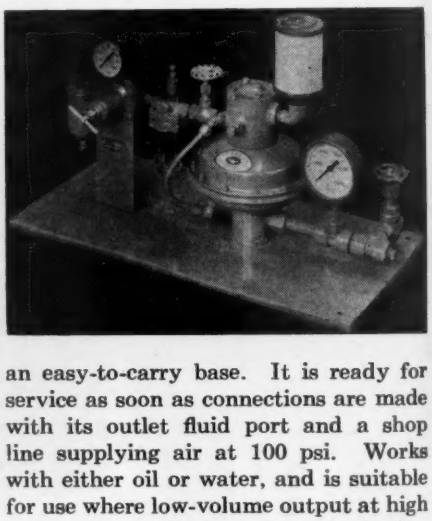
Sprague Engineering & Sales Corporation has announced a new Hydraulic Power Package with an output range of 3500 to 30,000 psi for test purposes. The unit comes complete with air-operated pump, muffler, filter, lubricator, regulator, valves, etc., all mounted on



an easy-to-carry base. It is ready for service as soon as connections are made with its outlet fluid port and a shop line supplying air at 100 psi. Works with either oil or water, and is suitable for use where low-volume output at high pressure is needed, such as in hydrostatic testing. Operates automatically on the principle of differential areas and is furnished in six standard models with varying ratios from 35:1 to 300:1.

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A bomb that is helpful instead of harmful has been developed by Fyr-Larm Company of Syracuse, N. Y. Made to hang up, it is charged with gas which escapes when the temperature reaches 130°F, blowing a whistle to give warning that fire threatens.

---

Easily adjustable tie strings keep new hand protectors in place and facilitate removal. Pads are made of genuine horsehide for long wear for such purposes as handling brick, tile, metal sheets, stampings, sharp-edged castings, paper

and a variety of other products that are liable to injure workers' hands. Known as Safti-Mitt Handpads (Style 1201) they fit any size hand with comfort. They are offered by General Scientific Equipment Company, 27th and Huntingdon Streets, Philadelphia 32, Pa.

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Norton Company has announced a new hub-type wheel with which an operator can rough and finish grind and notch, work that normally requires the use of different wheels. It is made of a carded web material impregnated with an abrasive grain and is designed for use on right-angle or sander-type portable grinders. According to the manufacturer, the wheel is flexible and combines lightness with unusual strength, which is imparted to it by a safety web built into the back. Should breakage occur, the web is intended to hold the pieces together until the machine can be stopped. Known as the Norton BFR wheel, its primary use is to smooth down welds, blend surfaces on contours and notch risers in all kinds of castings.

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Solid waxes in stick form are a new product of S. C. Johnson & Son, Inc., for metalworking operations such as sanding, sawing, pipe cutting and threading, drilling, tapping, grinding and flush riveting. Designated as No. 140 Stik-Wax, it can be applied manually as needed or set in position for application as machine operates. According to the maker, the lubricant lengthens the life of tools, gives work pieces a better than usual

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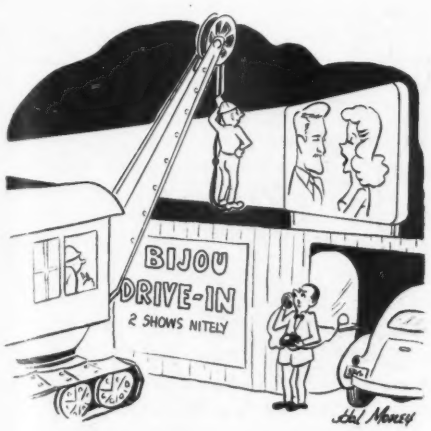
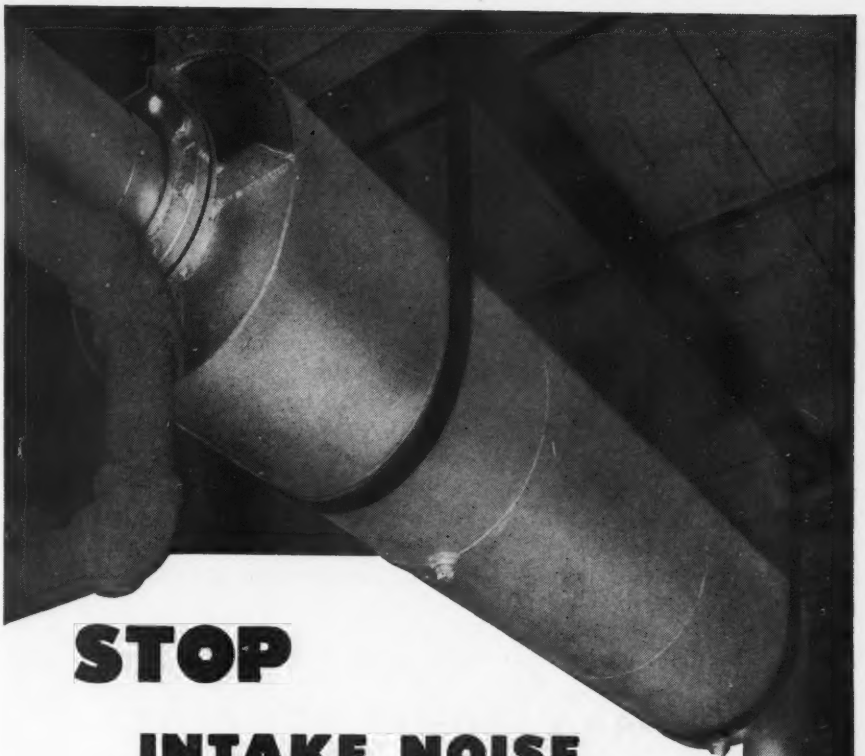



"Hello, Ace Construction Company? I have a complaint."

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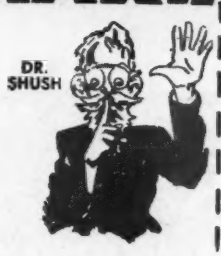


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## *Getting Drier Compressed Air*

● Direct saving in the cost of cooling water saves the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

Extra, for no cost, the drier air gives you a better operation and lower costs in the use of all air-operated tools and machines, paint spraying, sand blasting or moisture-free air cleaning. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter by the Niagara Balanced Wet Bulb Control.

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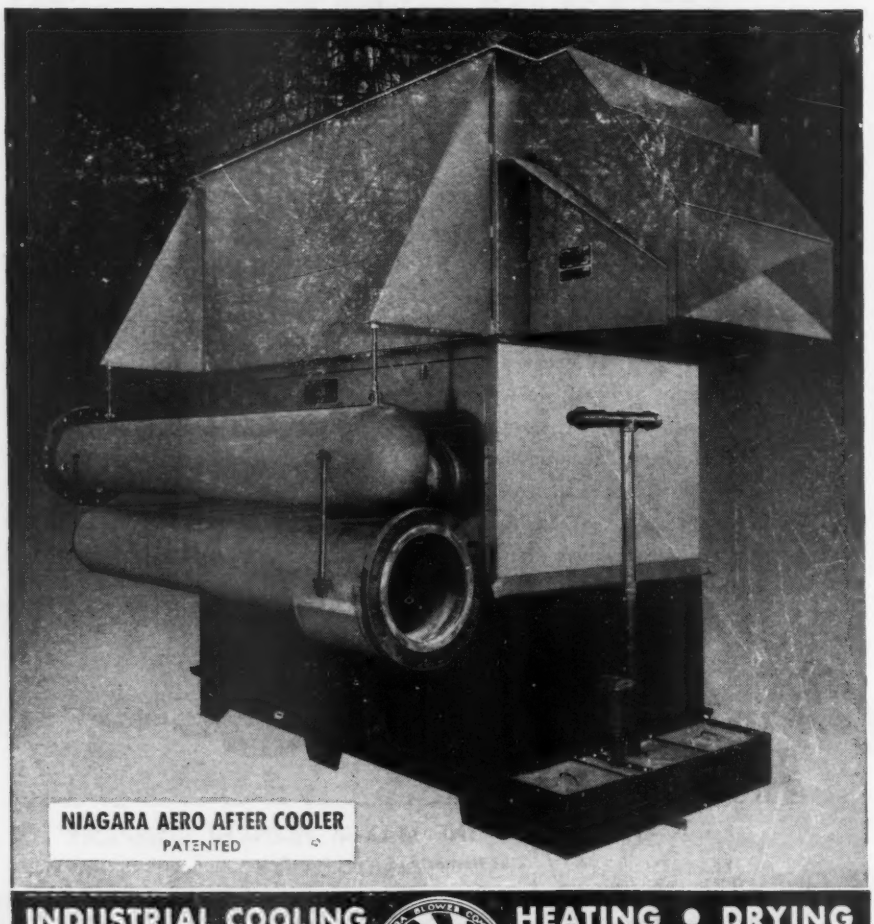


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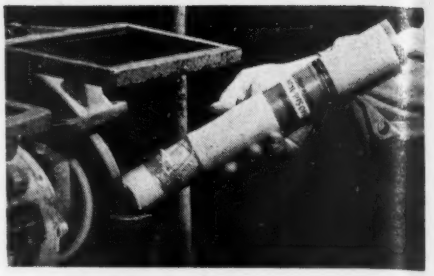

finish and eliminates burrs when metal is cut or drilled. Stick is 2 inches in diameter and weighs a pound. Obtainable from distributors of Johnson Wax lubricants and coolants.

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C. A. Norgren Company has added a new pressure regulator to its line of pneumatic products that is said to be the first of its kind to insure precise control at low air flow (0-2 cfm) at a reasonable cost. It is designed for use with air-controlled instruments but is also applicable to any process requiring nitrogen or other inert gases. The unit operates on primary line pressures up to 400 psi, with delivery pressures ranging from 0 to 30 psi, and is equipped to prevent build-up of excessive pressures that might affect instrument performance or damage parts.

---

By a new system of Cool Grinding developed by The DoAll Company, the heat generated during the process of cutting tool-steel alloys is dissipated sufficiently, it is claimed, to prevent cracking and "skin" softening. This is done by forcing the coolant through the wheel instead of pumping it on to the work piece, where the air blast created by the spinning wheel keeps the solution away from the area where it is most needed—under the wheel. In the case of the Cool Grinding method, the coolant drips into a retaining groove in the wheel and is atomized by centrifugal force, thus flushing the wheel and actu-

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**"It's just a disguise to protect his tool chest."**

ally keeping it saturated. Coolant feed is controlled by regulators with visual flow gauges. The company reports that optical pyrometers have indicated reductions in cutting temperatures of as much as 600° by its system. Ordinary vitreous-bonded wheels can be used because they are porous enough to permit coolant flow.

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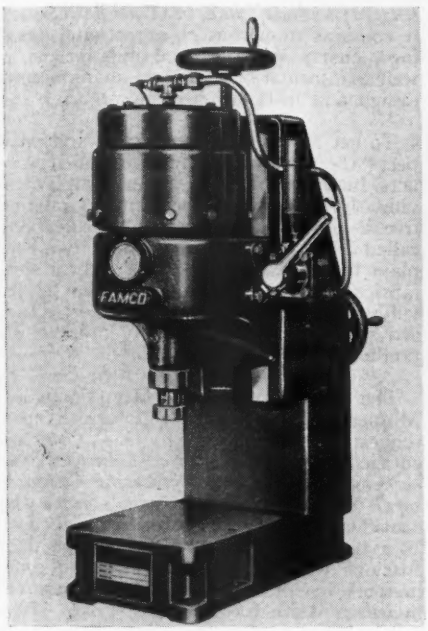
Variable and sensitive pressure control is one of the features of a new line of air presses built by Famco Machine Company for continuous operation ranging from heavy crimping, forming, pressing and embossing to light work such as assembling delicate instruments, jewelry, etc. The power unit is a Bendix-Westinghouse frictionless cylinder of the diaphragm type with spring return and is said to insure millions of strokes without the maintenance problems caused by faulty piston rings, leakage, etc. It can be adjusted vertically by loosening a cam and turning a hand wheel. There are five types of four sizes each, with single or dual air or electronic control. The press shown is a single air-control unit which delivers a squeeze pressure of 3835-6335 psi at maximum stroke (4 inches) with air at 80-150 psi.

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The last of 47,000 machine tools in a Navy stockpile has now been taken out of "mothballs" and put to work by contractors making materials for the Army, Navy and Air Force. From 1945 to the time fighting began in Korea, the Navy had acquired and repaired 40,000 tools, worth half a billion dollars at today's replacement prices. In succeeding months it purchased 7000 others. They were gradually doled out to avoid bottlenecks in the production of strategic materials. The final allotment disposed of 10,000 machines.


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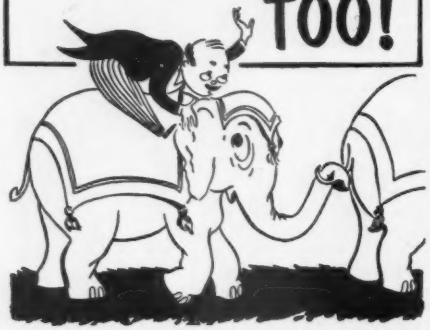

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## Books and Industrial Literature

Corporation executives and others with or without a technical accounting background, as well as financial officers, accountants and instructors will find a wealth of helpful information in the 1952 edition of *Mapi Accounting Manual*. It is a sweeping revision of the preceding work, since which time new accounting and financial problems have been born, some have matured and the work of accounting in the capital-goods and equipment industries has become increasingly complex. The new cloth-bound 1210-page manual contains ten sections on financial statements and reports; property, plant and equipment; sales engineering and administrative expenses; profit planning and budgeting; pensions and recognition of changing value of the dollar, among others. Published by Machinery & Allied Products Institute, 120 S. La Salle Street, Chicago 3, Ill. Price, $15.00.

*Tool Steel Handbook* is the title of a 197-page volume published by the Allegheny Ludlum Steel Corporation for engineers, teachers, metallurgists and others interested in tool, die and allied steels. The book starts out with charts and tables giving specific and comparative data on properties, analyses and applications. This is followed by detailed descriptions of all important grades, arranged alphabetically for easy reference. Succeeding chapters deal with the many forms and finishes available and with certain allied products such as Carmet carbides; heat treating and handling techniques as applied to tool and high-speed steels; and a complete set of weight tables and other useful material. Qualified persons can obtain a free copy on request to the company, 2020 Oliver Building, Pittsburgh 22, Pa.

Because of the current industrial changeover, many metalworking plants are using materials with which they are not familiar. To help them, The American Brass Company, Waterbury 20, Conn., has prepared two comprehensive, well-illustrated books on copper and alloys of copper. Publication B-14 deals with Anaconda free-cutting brass rods for the manufacture of screw-machine products. It contains much valuable information in its 24 pages, including the physical constants and properties of 46 rods. *Machining Copper and Copper Base Alloys* is the title of the second book —Publication B-3. In addition to suggesting cutting speeds, feeds, tool rakes and clearances for more than 40 different alloys, it gives many practical hints on turning, cutting-off and form tools; drills, reamers and taps; and thread chasers, milling cutters and coolants. Both are obtainable free of charge.

Barrett-Cravens Company, 4609 S. Western Boulevard, Chicago 9, Ill., is offering a bulletin (5110) describing and illustrating its line of single-stroke hand lift trucks, which are available in capacities up to 4000 pounds.

Air, gas, steam and liquid relief valves made by Kunkle Valve Company for original equipment are dealt with in an illustrated folder obtainable upon request addressed to 130 S. Clinton Street, Fort Wayne, Ind. Subject matter includes new Kunkle designs and valves formerly made by the Star Brass Manufacturing Company.

Catalogue No. 250-E-1, obtainable from American Hoist & Derrick Company, St. Paul 1, Minn., has to do with its portable material elevator that features an interchangeable platform and ½-cubic-yard concrete bucket. Quickly erected, it serves heights up to 96 feet, travels 90 feet per minute and handles loads up to 2500 pounds.

Electric-motor repair shops may be interested in the announcement of a new 3-phase coil winder head that winds any mush-type coil from 2¼x5 to 11½x19½ inches for motors ranging from ¼ to 75 hp. One of its features is said to be an instantaneous tension release. For information on this new device write to Dept. A., Crown Industrial Products Company, Park and Borden Avenue, Sycamore, Ill.

Those concerned with boiler operation and maintenance should be interested in a new 24-page catalogue and data book offered by Ramtite Company, Division of the S. Obermayer Company, 2563 W. 18th Street, Chicago 8, Ill. Titled *Boiler Settings with Plastic and Castable Refractories*, it contains numerous cross-sectional drawings, charts and technical illustrations, as well as information about the manufacture, design and installation of refractories.

To get across to its customers and prospects the story of its facilities and products, International Steel Company of Evansville, Ind., has published and is offering free a profusely illustrated 44-page book called *This is International Steel*. It makes plain that the concern is not only a steel fabricator but also a manufacturer of revolving industrial doors of all kinds, standard steel buildings and many other allied products.

The Electric Machinery Mfg. Company, Minneapolis 13, Minn., will furnish upon request copies of a paper by G. L. Oscarson entitled *Application of Direct-Connected Synchronous Motors to Reciprocating Compressors*. The article deals largely with the consideration of proper rotor flywheel effect as a preventive measure for voltage fluctuations when driving reciprocating compressors by direct-connected synchronous motors. Write for Publication No. 1200-TEC-1111.

*Dust Recorder Checks Operation of Precipitators* is the title of a bulletin offered by Minneapolis-Honeywell Regulator Company. It fully describes the new General Power Plant Corporation's gas analyzer with a Brown ElectroniK potentiometer which gives a continual record of the dust content of any atmosphere where there is a minimum dust concentration of 0.0003 grain per cubic foot. Address your request for Honeywell Instrumentation Data Sheet No. 10.14-6 to the company's Brown Instruments Division, Station 40, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Those with problems pertaining to expansion, contraction and offset movements of pipes and conduits may be interested in a 40-page catalogue published by Solar Aircraft Company, maker of industrial expansion joints and aircraft bellows. Several unique designs are described, as well as unusual installations for absorbing motion resulting from pressure or temperature changes in conducted gases or liquids. The bellows assemblies are manufactured for pipes ranging in size from ½ inch to 72 inches and for pressures from vacuum to 1000 pounds. Catalogue No. 51 may be obtained from the company, 2200 Pacific Highway, San Diego 12, Calif.